The New Zealand

Journal of Agriculture.

VOL. XL. WELLINGTON, 22ND APRIL, 1930. No. 4.

THE EVOLUTION OF GRASSLAND FARMING IN NEW ZEALAND.

Paper presented by A. H. COCKAYNE, Assistant Director-General, Department of Agriculture, to the Empire Farmers' Conference, held at Wellington, 24th March, 1930.

DURING the tour of the Empire Farmers' Delegation in both Islands of New Zealand the development of our farming systems must of necessity have been largely viewed with reference to British conditions and British traditions based on centuries of experience. In this paper I wish to bring forward some of the main New Zealand viewpoints built on an extremely short agricultural history, but one which has undergone far more rapid evolutionary changes than would ordinarily be considered possible by any one from a country where agriculture has become stabilized.

Less than a century ago New Zealand consisted mainly of four great types of country :—

(1) Forest of varied and often very dense nature, belonging to types essentially different from those originally clothing great parts of Britain.

(2) Scrub and heath lands, partly of a stable nature, but mainly representing one of the successional stages back to forest.

(3) Large areas of swamp land, the cover varying from fen vegetation to forest.

(4) Open grassland, known as tussock grasslands, which had developed entirely in the absence of any grazing-animals, and which were essentially climatic in origin.

Roughly expressed, the wetter areas of New Zealand were covered in forest and the drier areas were in natural grassland. Known methods of cultivation and stocking were of no value in bringing into agricultural profit the vast areas of forest-clad country, so it was on the open unforested country that development first took place, and, as these areas occurred mainly in the South Island, that portion of New Zealand showed in the earlier years the greatest advancement. The original farming community, recruited as it was with excellent British farming experience, rapidly adopted rotational practice on the more fertile, easily ploughable tussock grasslands, and depastured ever-increasing flocks of merino sheep on the natural tussock areas

where topographical considerations precluded easy ploughing. To commence with, cereals and wool represented the only saleable commodities that did not reach immediate saturation-point, and had it not been for two factors the agricultural development of New Zealand might have remained comparatively insignificant. These two factors were the comparatively early discovery that a good seed-bed for the establishment of pastures of European grasses could be produced by felling and burning the forest, and the later development of cold-storage processes enabling meat, dairy-produce, and other perishable products to be exported.

The conversion of forest into grassland without the intervention of the plough represents the first major development in the evolution of New Zealand farming, and has resulted in over 12 million acres of grassland replacing forest. The firestick therefore became the real emblem of farming progress in New Zealand for many years rather than the plough, although it was considered that the majority of ploughable "bush-burn" country would finally come under some sort of rotational treatment whereby the production of fresh young grass would be connected up with the production of annual crops, either of a cash-sale or animal-feeding type. For many years from 200,000 to 400,000 acres of forested country were annually burned and grass-seed sown on the scarcely cooled ash. The forest did not in all cases surrender to the artificially produced grass invader without a valiant struggle, and a whole range of stocking and secondary-burning technique became developed to cope with the efforts of forest to again reassert itself.

Until the development of the freezing industry the artificially produced bush-burn grasslands and the natural grasslands were essentially used for wool-production. Meat in the quantities in which it could be produced was unsaleable; the value of a carcass was measured in terms of the tallow that it could yield, and thus arose the boiling-down establishments of both Islands. Over the greater part of the bush-burn grassland long-wools—firstly Lincoln and later Romney—became the dominant breed. The rise of the Romney coincided to a certain extent with the gradual fall in nutritive value of the bush-burn pastures as they passed through successional changes tending to a lower standard.

The capacity to export meat and dairy products, commencing with the first trial shipments in 1882, gave New Zealand the opportunity to develop itself into the dairy and fat-lamb farm of the Empire; and, going back a stage further, it can be said that it is due to Faraday's classical researches in pressure on gases that New Zealand owes the greater part of her farming progress. From the "eighties" New Zealand's farming future became definitely a grassland one; but full recognition of that fact did not become general for many years after and is hardly yet sufficiently appreciated. The development and improvement of grassland was hardly viewed as farming at all, due to the inherited thought among the farming community that the plough was the only true symbol of agriculture, and that grazing without extensive cropping merely represented a stop-gap for the time being.

Two factors of great importance developed comparatively early in the history of grassland for wool-production. These were the presence

of sheep-scab and the development of the rabbit pest. Due to the untiring efforts of the Government, sheep-scab was in a comparatively short space of time wiped out by a rigid system of inspection, treatment, and final elimination of all scabby animals. The rabbit pest for many years was a serious menace to production on lower-value grassland, and did not finally become of minor importance until the introduction of strychnine poisoning, coupled with the steadily increasing value for the skins, making control a much less complicated matter.

So far as the mountainous natural tussock grasslands are concerned, their history has been one of gradually diminishing fertility, and as their area is large—over 14 million acres—and their production and value low, they can be viewed with our present knowledge as probably a potentially decreasing asset in connection with farming, unless better feeding types of vegetation can be established on them at a nominal cost. Investigation in this direction, however, has not been by any means encouraging. On the other hand, it is far otherwise with the sown grasslands of the country, which, with their companion annual stock-feeding crops (themselves now steadily decreasing in proportion), comprise some 18 million acres. This area of sown grassland at the present time is only slowly extending in comparison with the bush-burn days, as most of the virgin country still to be won to payable grass is mainly almost of a submarginal character, particularly during eras of falling prices.

The main production from this 18 million acres consists of meat, wool, and butterfat, and by-products such as hides, pelts, &c., connected therewith. The sown grasslands of the Dominion are responsible for an annual output of roundly 250,000 tons of meat (mutton and lamb 200,000 tons, beef 30,000 tons, pork 20,000 tons), 70,000 tons of wool, and 140,000 tons of butterfat. Brought to a per-acre basis this means about 30 lb. of meat, 9 lb. of wool, and 17 lb. of butterfat.

With normal prices the present annual value of grassland products exceeds £50,000,000, a figure that could quite easily be doubled by better appreciation and application of scientific grassland-management. The value of such management and all that it stands for is fast becoming recognized not only by the farming community, but also by all commercial, political, and scientific interests.

Grassland products in the shape of these saleable commodities, primarily elaborated by the cow and the breeding-ewe, represent in New Zealand farming the dominant features of production. Not only do they far outstrip in value the combined production of all other agricultural endeavour, but their potential development, provided adequate marketing avenues are opened up, is so great that it can be safely said that New Zealand's farming future definitely lies mainly along the line of their expansion. This recognition that grassland farming, as distinct from rotational farming or extensive grazing, in a country with the climatic advantages of New Zealand can be as highly technical and complicated an art as any farming where the plough plays a dominant part may be viewed as the outstanding feature in our agricultural thought of the present day. For many years the European conception of grass as a limited seasonal crop necessitating, so far as milk and fat-stock production are concerned,

ample provision of specially grown crops was universally held in New Zealand, and yet growing up within the country itself, particularly in the districts of better rainfall, there gradually became established the idea that manipulation of both grass and stock could be so directed as to, in many cases, avoid any extensive growing of special crops.

Probably the most important direction taken in grassland-management, to minimize the weakness of grassland so far as seasonal production is concerned, was the trend to make ever-increasing use of female animals, in the shape of the dairy cow with a definitely dry period during winter and the breeding-ewe with a definitely high feed-requirement in the spring and summer. During recent years the proportion of dairy cows to total cattle wintered and of breeding-ewes to total sheep wintered has steadily increased, and can be viewed as the definite trend of development. From this, two outstanding theories in regard to grassland-management were evolved. Firstly, that the feed requirement of the grassland farmer should be at its lowest point in the winter, and, secondly, that summer-grass production should be converted into milk—in the case of the dairy-farmer represented by butterfat sold as such, and in the case of the sheep-farmer by the fat lamb.

This second theory — that as large a proportion as possible of the summer growth of grass should be converted into milk — made it essential that such herbage should be of a milk-producing type. In other words, that it must be young, vigorous-growing, highly mineralized, and high in available protein. In this connection it is interesting to note that high-class grass in New Zealand may contain up to and over 30 per cent. of protein, making it remarkably suitable for milk-production.

At the present time New Zealand grassland-farming practices are largely centred on the development of the three following phases :—

(1) The production of better conditions for pasture growth.

(2) The provision for better management and better facilities for better utilization.

(3) The provision of stock better suited to influence directly the economic efficiency of better conditions and better utilization.

All these three phases of grassland-management are being developed, intensified, and standardized—in certain instances with a rapidity that savours of the magical, but in others quite slowly, indicating clearly the complexity of the whole general problem and that of the "unknown" emerging with every forward step taken. The main features that rapidly pass through one's mind in considering these three phases of grassland-farming practice are clear enough, even though the list be long. They comprise drainage, fertilizing, liming, surface cultivation, hay and ensilage making, mowing of surplus growth, smaller paddock subdivision, more adequate watering, shelter, disease-control, and breeding under tested control.

The greatest single factor at the present time that is commencing to greatly stimulate production from grassland is top-dressing. The area top-dressed is being increased at the rate of many hundreds of thousands of acres annually, and well over 300,000 tons of fertilizers, almost all of a phosphatic nature, are being used on grassland in lengthening both the growth-period and increasing the actual pro-

duction of high-protein grass. In addition, about one-quarter of that quantity of lime is being used, mainly in the shape of ground limestone. Even though top-dressing has increased greatly of recent years, the total area annually dealt with is still well under 3 million acres. I forecast that within the next decade—provided expanding and payable markets are maintained—our top-dressing tonnage will reach the million mark. The fact that most New Zealand soils are naturally low in phosphates makes phosphatic fertilizers of first consideration, but the change from single to more complete manuring, where lime, nitrogen, and potash steadily gain in importance, is not far distant. So far as lime and nitrogen are concerned, future requirements need give us no concern, but the safeguarding of adequate phosphate and potash supplies is of the very first importance.

Another development that is just making itself felt in the more highly developed grassland districts is the conservation of surplus summer herbage as ensilage. The making of grass ensilage has proved itself not only of immense value in pasture-management, but provides a summer supplementary feed that is unsurpassed in reliability by any crop that can be summer-produced, with perhaps the exception of lucerne, a crop unfortunately that has a comparatively narrow range in New Zealand.

Of perhaps more real significance than any other feature of grassland farming, and at present barely recognized, is the question of strain so far as the actual grass crop is concerned. Along this line work somewhat similar to that being conducted at the Welsh Plant Breeding Station is being carried out by the New Zealand Plant Research Station. It has clearly shown that the running-out of pastures is due very largely to the types sown being of a bad or non-permanent character, and that when leafy persistent types are used all those methods of modern management leading to higher production are rendered far more economical and efficient. So far as perennial rye-grass is concerned the work is well advanced, and other grasses and clovers are being brought under study. The pedigree grass, capable of maximum returns under the hard stocking conditions contemplated by what has been termed rotational grazing, is really as essential as pedigree stock if anything like full utilization of grass-growth is to be realized. Recognition of this fact and the application of that recognition is destined to play an even more important role in New Zealand grassland-management than any of the milestones which have been passed in the history of New Zealand farming.

Failure to establish high-class permanent pasture, even on first-class land after the land has been ploughed, has been all too common in New Zealand, and has led to the idea that it is generally better to improve existing grassland by liberal management rather than by renewal. The idea has in many cases been perfectly sound where the seed mixtures used, although permanent in name, are temporary in effect. So soon, however, as reliability can be given to the strain and real leafy permanence of the seed for laying down permanent pasture, very large areas of the present established grassland of inferior botanical composition will be renewed, with astonishing results so far as production economy in management is concerned.

Improvement in grass and clover strain, improvement in growth-conditions, improvement in utilization, and improvement in stock

attuned to grassland-management conditions — all of which are being rapidly developed and applied — make it clear that grassland products will enormously increase in the near future, and the estimate of a doubling of our production in a comparatively short space of time is likely to become a reality. It may bring in its train several grave difficulties, particularly those of marketing. Another weakness is that grassland farming offers only a limited variety of output, and in seasons when prices for both cow and ewe products are depressed the farmer's financial position may become embarrassed. Nevertheless, the future destiny of New Zealand, to my mind, is grassland farming developed to its very highest stage. Many other features of land-utilization will no doubt develop and extend, but they are unlikely to ever overshadow in any way New Zealand's capabilities for growing milk-producing grass.

Of the 18 million acres of sown grassland and auxiliary forage crops under grassland farming, probably about 5 millions are used for dairying, and 13 millions for sheep with their accompanying beef animals. A very large area of this dairying-land is, comparatively speaking, in a more or less unimproved state compared with fully developed pasture. If one takes 4 million acres as the area dairied on, the average yield is about 70 lb. of butterfat per acre. When it is considered that under present conditions yields of over 250 lb. per acre have been realized, the potentiality for increase in dairy-products is quite evident. In fat-lamb production, again, highly top-dressed farms are now carrying six and seven ewes to the acre, which before top-dressing did not do better than two; and when one considers that top-dressing and special sheep-grassland management is only in its initial stages, the outlook for the ewe is as favourable as that for the cow.

Lamb in ever-increasing quantities, mutton in comparatively slowly increasing amounts, increased quantities of wool (particularly of qualities ranging from 40's to 50's), and an enormously increased amount of butterfat indicate our main grassland products export bill of fare.

A feature in our dairying that must have struck members of the delegation is the comparatively small use made of pigs. There is about one breeding-sow in New Zealand to every twenty cows, and the total annual amount of meat derived from the progeny of each sow is about 700 lb., or somewhere about 40 lb. per cow. This extremely poor result is in many quarters attributed to the fact that owing to the high cost concentrate feeding is not payable. There seems little doubt, however, that increase in pork-production could be largely brought about by reasonable management connected up with our grass-farming system. Unfortunately at the present the argument is that we should adopt feeding and management systems in vogue in other countries, instead of working out a system that is applicable to our own conditions. In our agricultural history it has been the adaptation rather than the adoption of method that has made for progress, and the same undoubtedly will be true in the pig industry. I am convinced, however, that sooner or later pork in large quantities will rank as our second, if not main, meat export,

but before that comes about the development of a system in tune with our grassland management must be evolved.

This paper has dealt entirely with the evolution of grassland farming here. There are, of course, other avenues of production which, although small in comparison, are important enough. Some are certainly capable of extension, others will fade away, and others, again, may be maintained for fiscal or other reasons.

Over parts of the drier area of the South Island sown pastures tend to rapidly revert to a dry-stock-carrying basis and have to be renewed, necessitating the farm team or tractor as an integral basis of management. Rotation farming has therefore to be adopted, and in consequence both autumn- and winter-sown crops are necessary for economical distribution of cultivation costs. Cereals, particularly wheat, are especially useful in this direction, and wheat-growing has to be carried out. We grow an average of about 200,000 acres of this cereal, with a yield of over 30 bushels, and, provided protection is afforded, wheat-growing is likely to expand in relation to population increase. Oats, on the contrary, are a diminishing crop, the internal-combustion engine having rapidly restricted the supplies necessary. As to barley, some 20,000 acres provide sufficient for our requirements. Cereals, other than oats, for the production of stock-feeds play little part, as their cost, and particularly their transport costs, preclude their extensive use. The outlook for the arable rotational farm is not particularly good, but it is possible that certain special crops may become developed which will help to pay for the farm team. In this connection the growing of grass and clover seeds of pasture-strain types would appear to offer great promise, both for local use and for export. Real "mixed farming" in suitable districts may, indeed, have a strength all its own.

STATISTICS OF FARM MACHINERY AND ENGINES.

FOLLOWING is a summary of farm machinery and engines employed on rural holdings (outside borough boundaries) in New Zealand for the past five years:—

Class of Machinery, &c.	1925.	1926.	1927.	1928.	1929.
Milking-plants	15,561	16,391	17,090	18,049	18,756
Cream-separators	44,656	45,765	45,246	45,246	45,781
Shearing-machines—					
Plants	5,728	5,949	6,305	6,518	6,887
Stands	18,445	18,797	19,269	19,677	20,329
Wool-presses	8,601	8,641	8,832	9,504	9,235
Agricultural tractors	1,026	2,025	2,588	2,883	3,377
Reapers-and-binders	15,881	15,574	15,287	15,432	15,172
Threshing-machines	377	361	364	406	406
Chaffcutters	2,903	2,865	2,562	2,326	2,297
Water-wheels or motors ..	846	817	784	932	824
Electric motors	3,451	6,356	8,436	10,806	13,377
Steam-engines	622	473	435	505	397
Internal-combustion engines ..	19,894	19,584	18,885	18,321	18,489

—Census and Statistics Office.

IODINE DEFICIENCY AND LIVE-STOCK.

A PRELIMINARY INVESTIGATION IN THE WANAKA AREA.

1. Goitre in Lambs.

C. S. M. HOPKIRK, Officer in Charge, Wallaceville Veterinary Laboratory, and C. V. DAYUS, District Superintendent, Live-stock Division, Dunedin.

MANY parts of New Zealand are known to be short of iodine in the soil and water, but this is particularly the case in the Cold Lakes region of the South Island. Nevertheless it is not common to find more than an odd case of goitre in farm animals in the deficient districts. In October of last year, however, one station-owner in the Wanaka area reported the birth of a large number of lambs with enlarged thyroid glands. The history of the occurrence may be given as follows.

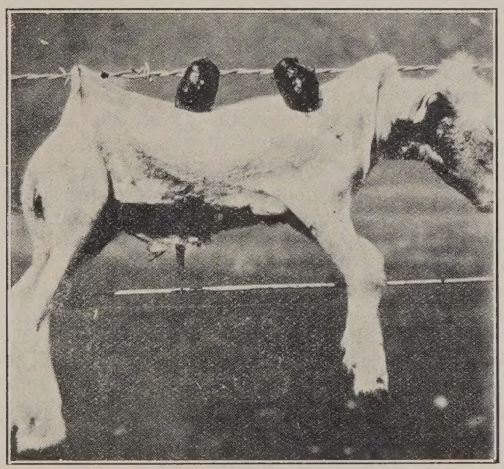
A flock of 1,400 crossbred ewes was run on 600 acres of flat at the base of a high range of hills. The flats are rich and grow good feed, mainly English grasses and clovers, though cocksfoot tends to become dominant over the rye-grass. Winter fodder, consisting of turnips and clover hay, is also grown on these flats, so that animals do not get food which has been grown in another district, and therefore any deficiency present in the soil is reflected in the pasture and eventually in the sheep. Some 300 of the 1,400 ewes had been brought down from the hills and placed with the flock one year previously, as representing the strongest-woolled of the hill sheep. The other 1,100 had been on the flats for two years, and it was lambs from the 1,100 which were affected. About 200 merinos were also wintered on the flats for the one season only.

The pastures had been down for a number of years, but some were five and six years old only. The flats were divided into paddocks of 30 to 50 acres. Previously to 1926 no top-dressing had been done. Since then some of the paddocks on the farm had been top-dressed once or twice, while others had received no treatment. Sulphate of ammonia had been applied only to a few acres, and not in the paddocks referred to. The health of the sheep was good, and they were in good condition. Ante-partum paralysis was held in check by judicious feeding and exercising, and pulpy kidney occurred in only six lambs during the early season of 1929, but more died at twelve to fourteen weeks from that trouble. The affected sheep had been fed for the last two years on a lick composed of salt, 112 lb.; Kerol, 2 pints; iron sulphate, 2 lb.; sulphur, 4 lb.; rock phosphate, 4 lb.; calcium carbonate (97 per cent.), 20 lb. An amount of 30 cwt. had been fed over the year.

The ewes commenced lambing in October, and over a hundred were born with enlarged thyroids, the enlarged lobes being from a hazel-nut to a duck's egg in size. Some of the larger glands were cystic. Analysis of these thyroids carried out by the Chemical Laboratory of the Agriculture Department showed from 0·0009 per cent. of iodine by weight of gland to 0·0296 per cent. in the case of a gland which was almost normal in size. Dr. Orr, of the Rowett Institute, gives the normal fœtal gland as 0·03 per cent. The majority analysed were in the vicinity of 0·001 per cent. Besides enlargement of glands the lambs

showed other definite symptoms of iodine deficiency, such as hairlessness, smallness of fœtus, a tendency to œdema, and in some cases coarse hair instead of the usual lamb's wool. If the lambs were born alive and remained alive for three days there was some hope of their living, but many born alive died from weakness without getting on their feet.

Further post-mortem examination showed œdema of the meninges of the brain, some congestion of mid-brain, but no definite hæmorrhage



ONE OF THE DEAD LAMBS IN WANAKA AREA.
The enlarged thyroid glands have been taken out and are seen above carcass.

was seen. The heart was petechiated, and there were hæmorrhages on endocardium. The pericardial sac was filled with fluid; bladder usually full; kidneys œdamatous, pale, not firm when capsule stripped; some small areas of congestion showed as mottling through the capsule of the kidneys.

One lamb which was found alive and taken to the house for treatment was given three drops of tincture of iodine in milk three times per day, and in a week was practically normal, the goitre having almost disappeared. In lambs which lived three days, however, the thyroids tended to decrease in size without treatment.

2. Various Aspects of Iodine Deficiency and the Wanaka Investigation.

B. W. Simpson, Rowett Research Institute, Scotland. (On loan to Chemistry Section, New Zealand Department of Agriculture.)

Since iodine is a necessary element in biological processes, its presence in soils, pastures, and animal tissues is of fundamental significance. An investigation into the cause of a high mortality among lambs in the Wanaka area resulted in some interesting data; a description of the occurrence has been given in the preceding section.

At Makarora, up the valley from the head of the lake, the stock was poorly developed—especially yearling calves, which were small of size — sterility was prevalent, and cream-production very low, although the pastures seemed luxuriant and rich. Rams brought into this district grew coarse-haired, and the wool only recovered its fineness when the animals were removed to other pastures. Hairlessness in lambs was also noted. An iodine deficiency was obviously the primary cause of the weak stock in a case near the lake itself. Samples of soils, pastures, milk, and thyroid glands were taken for analysis.

Soils.—The iodine content of soils varies considerably, being in New Zealand anything up to 900 parts in 10 million. Three soil-samples taken from Wanaka gave an iodine content of 6, 15, and 7 parts in 10 million. A soil from Islington, near Christchurch, for comparison, gave 28 parts in 10 million. Two samples from Makarora gave 2 and 15 parts in 10 million. These five soil-samples from Wanaka have extremely low iodine contents.

Pastures.—There is little or no correlation between the iodine content of a soil and the iodine content of the pasture grown on it. Some soils, although rich in iodine, give up none to plants. Generally speaking, these are alkaline soils. Acid soils, on the other hand, give up their iodine very readily to plants.

As there exists a very critical iodine dosage for plants, as well as for animals, above which toxic processes set in and below which full development does not take place, it can be understood why field trials with iodine manuring are often very contradictory. The empirical application of iodine to soils in manures and otherwise is therefore generally useless. If the nature of the soil is not taken into consideration the result may well be, as far as the crop is concerned, nil, or a diminution instead of an increase may even result if the optimum dosage is exceeded. Hilly pastures in New Zealand are generally richer in iodine than valley pastures. This is of interest, because at Wanaka the lambs of hill sheep are healthy; only those of paddock sheep are affected. The soils at Wanaka which had an iodine content of 6, 15, 7, 2, and 15 parts iodine in 10 million grew pastures with 13, 32, 11, 14, and 13 gammas * iodine per 100 grammes of dried material respectively. An Islington pasture, grown on a soil with 28 parts iodine in 10 million and sampled at the same time of the year as the Wanaka pastures, had 95 gammas iodine per 100 grammes dry material. The Wanaka pastures are low in iodine, and this in spite of the fact that the Wanaka stock was getting iodine licks from boxes in the paddocks, so that the natural iodine content was probably much lower.

Milk.—Iodine is always found in milk. In New Zealand milk-samples the iodine content varies within narrow limits. Milk-samples from the Whangarei area have generally about 6 gammas iodine in 100 c.c., and samples from the Christchurch area about 4 gammas per 100 c.c. One sample from Wanaka contained 2 gammas, and another had only about 1 gamma per 100 c.c.

Thyroid Glands.—The thyroid gland contains a higher percentage of iodine than any other tissue in the animal-body. A deficiency of iodine in the food of an animal reacts on the thyroid gland in such a

* A gamma (γ) equals one-millionth part of a gramme.

way that an inverse relationship exists between the size of the gland and the iodine content. Glands from the Wanaka area are very large and contain very little iodine. No. 2 of Table 1 may be taken as normal for comparison. Dr. Orr found the thyroids of fœtal lambs to have about 0·03 per cent. iodine fresh weight. A Wallaceville lamb had a thyroid weighing 0·9 gramme with an iodine content of about 0·06 per cent. fresh weight; this animal was about six weeks old. The Wanaka lamb thyroid weights and iodine contents were as follows:—

Table 1.—Analyses of Lamb Thyroid Glands, Wanaka Area.

No.	Weight of Gland.	Percentage Iodine.	Iodine Content.
	Grammes.		Grammes.
1	27·0	0·0009	0·0002
2	3·2	0·0296	0·0009
3	10·8	0·0012	0·0001
4	60·9	0·0005	0 0003
5	32·3	..	..
6	202·7	0·0007	0·0014
7	21·1	0·0106	0·0022
8	46·3	0·0525	0·0243

The first five samples are glands of lambs dead at birth or about three days old. The last three glands were obtained from animals which had been fed on iodized lick for four weeks previous. At Makarora a sheep's thyroid weighing 4·6 grammes gave an iodine percentage of 0·02. A Whangarei sheep's thyroid weighing 7 grammes had an iodine percentage of 0·2, and an Islington sheep's thyroid weighing 6 grammes had 0·1 per cent. iodine. These are given for comparison. At Makarora a foal which died eighteen hours after birth had a thyroid weighing 37·4 grammes with an iodine percentage of 0·003. The iodine content of soils, pastures, milk, and thyroid glands from this Lake country area is therefore low when compared with the iodine content of similar samples from other areas in New Zealand.

A study of the general analysis of milk and pasture samples from Wanaka (Tables 2 and 3) in order to ascertain if there is any further mineral deficiency has been rather complicated by the addition of salt licks to the foodstuffs. Cows' milk from Wanaka, when compared with cows' milk from Whangarei, samples being taken at the same time of the year and at the same stage of lactation, gave practically the same mineral content. Unfortunately no record of the yields was

Table 2.—Analyses of Cows' Milk.

(Results, except for iodine, are expressed as percentages on the whole milk.)

Locality.	Date.	Iodine (I_2).	Chlorine (Cl_2).	Phosphoric Acid (P_2O_5).	Calcium Oxide (CaO).	Potassium Oxide (K_2O).	Nitrogen (N_2).	Magnesium Oxide (MgO).
Whangarei ..	28/11/29	6γ	0·10	0·24	0·18	0·16	0·59	0·02
Wanaka ..	21/11/29	2γ	0·11	0·23	0·17	0·16	0·57	0·02

Table 3.—Analyses of November Pastures, Wanaka Area.

(Results, except for iodine, are expressed as percentages of the dry matter.)

Lab. No.	Locality.	Material.	Iodine in Gammas per 100 grammes Dry Material.	Phosphoric Acid (P_2O_5).	Calcium Oxide (CaO).	Magnesium Oxide (MgO).	Sodium Oxide (Na_2O).	Potassium Oxide (K_2O).	Nitrogen (N_2).	Iron (Fe).	Manganese (Mn).	Ash.	Crude Silica (SiO_2).	Alumina (Al_2O_3).	Sulphur (S).	Chlorine (Cl_2).
Z/1332	West of Lake Wanaka	Hay ..	13	0·65	2·54	0·83	0·07	3·89	4·8	0·029	0·007	11·6	0·61	0·05	..	0·35
1331	Ditto ..	Red clover	10	0·52	1·53	0·45	0·08	2·43	1·6	0·012	0·009	7·4	0·55	Trace	..	0·49
1333	,, ..	Pasture ..	32	0·56	1·90	0·56	Trace	4·61	4·9	0·019	0·014	11·4	1·13	,,	0·37	0·40
1334	,, ..	,, ..	32	0·79	1·25	0·45	0·14	3·50	3·4	0·014	0·019	9·3	1·31	,,	..	0·32
1335	,, ..	,, ..	11	0·85	0·83	0·54	0·15	4·15	4·0	0·022	0·011	10·7	2·67	0·02	..	0·65
1357	Makarora ..	,, ..	14	0·45	2·00	0·51	Trace	3·6	5·2	0·018	0·010	8·9	0·70	Trace	0·40	0·25
1358	,, ..	,, ..	13	0·82	1·01	0·41	..	3·86	4·5	0·013	0·027	8·9	1·03	,,	..	0·44
1359	,, ..	,, ..	17	0·98	2·28	0·35	0·07	2·62	5·5	0·019	0·018	9·0	0·99	,,	..	0·21

kept. The general analysis of November pastures from Wanaka is also of interest. The iodine content is low, in spite of the fact that iodized salt licks were fed from boxes on some of the paddocks. Chlorine and sodium contents are low and calcium is high.

The dosage of iodine now in use at the Wanaka stations referred to is 2 oz. potassium iodide in 112 lb. of salt, fed from boxes to which the ewes have easy access. Whether this is sufficient to prevent the recurrence of the high mortality among lambs will be seen next season. The optimum dose for a sheep is 3 to 4 grains per week. This small dose ensures the full effectiveness of a mineral ration by increasing the assimilation of calcic oxide, phosphoric acid, and nitrogen in the food. Ten grains a week is sufficient for a bullock or cow, and 6 grains for a horse or a pig. Poultry show a remarkable reaction to iodine feeding; $\frac{1}{10}$ grain of potassium iodide fed to a hen per week increases the iodine content of the egg 600 times. The eggs from hens on experiment in Wellington, to which potassium iodide was fed, were 100 per cent. fertile, and 85 per cent. of the chicks were pullets. If too large a dose of iodine is fed to hens the moult is very complete.

It has been suggested that the thyroid enlargements found at Wanaka may have a causal relationship to the feeding of a lick containing salt, Kerol, lime (obtained from a friable deposit found in the vicinity), and ground raw rock phosphate. Whether all or any of these ingredients aggravated the critical condition of the lambs it would be difficult to say. Thyroid enlargement is in many cases associated with limestone country, but no definite correlation between excess of calcium in the soil and incidence of goitre has been found. An experiment is to be carried out on rabbits, which may throw some light on this vexed question. A low iodine basal ration, consisting of hay, grain, and roots from Wanaka, is to be fed to the control group. A second group will get this basal ration plus lime, a third basal ration plus salt, and a fourth basal ration plus phosphates. If possible, other groups may be added. A comparison of the weights and iodine content of the

thyroid glands should be of interest. In view of the fact that all over Central Otago generally many lambs have small thyroid glands of low iodine content, it may be that at Wanaka some external factor in the shape of excess or deficiency of another mineral made a critical iodine balance definitely negative.

3. Notes on the Wanaka Soils and Pastures Analysed.

R. E. R. GRIMMETT, Analyst, Chemistry Section, Department of Agriculture.

In November, 1929, the writer spent several days in the Wanaka area investigating the field conditions, and collecting soil and pasture samples. The following notes refer to the samples analysed by Miss Simpson (as set out in Table 3 in the preceding section).

Samples Z 1331 and 1332 are respectively red-clover green growth and red-clover hay from the same paddock near Lake Wanaka. This is on alluvial flats close to the base of the hills, and is not irrigated. The soil, in common with the rest of the flats, is of schistose origin and silty texture, with in places a stony subsoil. The top-dressing was 2 cwt. superphosphate in the spring of 1929 only. The hay is from the same stack that was used for feeding the ewes during the winter.

Z 1333 is a sample of general pasture from a paddock sown down for nine years. It is on the flats, but receives very little irrigation water. White and red clover with cocksfoot form the bulk of the pasture, which includes also rye-grass, fog, hair-grass, Chewings fescue, crested dogstail, sweet vernal, Poa pratensis, suckling clover, and various weeds. The growth was green and of medium length, and had not been stocked during the previous fortnight. An iodide lick had been fed on this paddock.

Z 1334 is a sample of general pasture from a paddock, also on the flats, which has been irrigated for the last twenty years. The growth was fairly short and green, having had sheep on it for a fortnight. Rye and white clover were the principal constituents, together with cocksfoot, crested dogstail, red clover, Yorkshire fog, suckling clover, timothy, goose-grass, sweet vernal, and weeds. The top-dressing was 1 cwt. of super and 1 cwt. potash salts, in the spring of 1928 only. An iodide lick was being fed on this paddock.

Z 1335 is a sample of self-established pasture from an unmanured and unirrigated paddock on similar soil to the preceding. The growth was mainly cocksfoot, fog, white and red clover, Poa pratensis, Chewings fescue, danthonia, sweet vernal, goose-grass, and weeds. No lick had been fed here.

At Makarora the rainfall is much higher, and the growth, especially of clovers, is very luxuriant. The soil is mainly alluvial, silty, and derived from schistose rocks. Z 1357 is a sample of general cow-pasture, very green and lush, predominantly white and red clover, together with cocksfoot, fog, rye, brown-top, crested dogstail, timothy, and weeds. This is from the farm where improved milk-yield and rearing of calves was reported following the feeding of iodine. Manurial history: 2 cwt. carbonate of lime and 1 cwt. super three years ago, 2 cwt. super last season, and 2 cwt. super and 1 cwt. sulphate of ammonia this season (1929–30).

Z 1358 is a sample of short green general pasture (cow and sheep) from a farm four miles farther up the Makarora Valley than the preceding. The paddock is twelve years old, and was manured with 2 cwt. superphosphate in 1927 and again in 1928. Rye, cocksfoot, and white clover predominate, other pasture constituents being fog, brown-top, Poa pratensis, timothy, Chewings fescue, rushes, cotula species, hydrocotyle species, and other weeds. No lick containing iodine had been fed on this farm.

Z 1359 is a sample of general pasture from an adjacent farm on which also no iodine had been fed. This paddock has been grassed for six years and was top-dressed in the spring of 1928 and in the autumn and spring of 1929, each time with 1¾ cwt. superphosphate. The pasture is predominantly white clover, with rye, timothy, crested dogstail, fog, cocksfoot, red clover, brown-top, sedges, and weeds.

NOTE.—An account of the chemical composition of mica schist silts is given by Mr. B. C. Aston, Chief Chemist, Department of Agriculture, in this *Journal* for June, 1923, page 329.

EARLY-POTATO GROWING IN FRANKLIN COUNTY.

MANURIAL EXPERIMENTS AT PUKEKOHE, 1926 TO 1929.

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Notes on the Industry.

POTATO-growing is an important farming industry in Franklin County, and is carried out on the basic volcanic soil areas which form the northern boundary of the Lower Waikato Basin. The country consists of low rolling downs, rising occasionally into flat-topped volcanic cones, and was originally covered in heavy bush. The soil is extremely suitable for early-potato growing, being light in texture, dark red in colour, and naturally fertile. The volcanic area lies fairly near the sea, and does not suffer severely from frosts. On the elevated volcanic cones frosts seldom occur and are never severe. The mean annual rainfall is about 50 in., and is well distributed. January and February are usually the driest months, and July and August the wettest.

Farms producing potatoes fall roughly into two classes — namely, "truck" farms of about 10 acres, which produce early potatoes, onions, and other vegetables, and dairy-farms on which potato-growing is a side line. The farms which produce the earliest potatoes are situated on the flat-topped volcanic cones, the chief of which is Pukekohe Hill, where the winter frosts are not severe and early potatoes can be safely planted in winter. The earliest crops are planted from the middle of May to the end of June. On the lower volcanic areas, where the crops cannot be planted with safety before July owing to winter frosts, the growing of second-early potatoes is combined with dairying. Naturally the dairy-farms are larger than the truck farms, and range roughly from 30 to 100 acres and over in area.

Crop-rotation and Cultivation.

On the small truck farms which grow the earliest potatoes the land is usually kept under cultivation for three or four years, and then sown in pasture for a year or two before being again broken up for another course of cropping. Potatoes are usually the first crop taken after grass, and the land is skim ploughed in the autumn, disked, and then deep ploughed and worked up to a fine tilth with disks and harrows ready for planting in May or June. The early-potato crop is dug in September–October, and is followed by a second crop which is planted in November–December and dug in March–April. Two crops a year may be thus grown for three or more years in succession. The rotation, however, is frequently varied by growing onions, carrots, or cabbages in place of potatoes. Catch-crops of barley, lupins, or white mustard for green-manuring are often grown after the second crop.

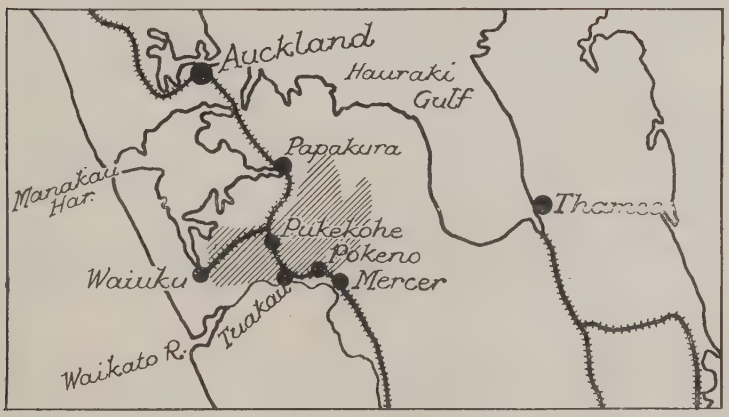

FIG. 1. MAP OF CENTRAL AUCKLAND DISTRICT, SHOWING EARLY-POTATO-GROWING AREA IN FRANKLIN COUNTY (SHADED).

On the dairy-farms potatoes are grown in rotation with grass supplementary annual crops, such as mangels and soft turnips. The potatoes are planted in July–August and dug in November–December. Mangels and soft turnips usually follow the potatoes, the mangels being sown early in specially prepared beds and transplanted after the potatoes are dug. The inclusion of potatoes in the cropping rotation on dairy-farms provides a valuable cash crop, which helps materially to reduce the cost of production of roots and green crops grown for the supplementary feeding of dairy cows.

For early crops, with which the haulms do not grow to a normal size, the potato sets are planted 9 in. to 12 in. apart in 27-in. rows. For the later-sown crops the sets are planted 12 in. to 15 in. apart in 33-in. rows. On truck farms the sets are usually hand-planted in furrows after the single-furrow plough, but the ridge plough is also used to some extent for planting. The fertilizer mixture is broadcast by

hand along with the sets. On dairy-farms and on level areas mechanical planters and diggers are often used in place of hand labour. As soon as the crop is up it is hand-hoed, and when the rows can be distinctly seen horse-hoed, followed later by another horse-hoeing and finally a moulding.

Varieties and Seed.

Northern Star (Gamekeeper) is about the only variety grown. It withstands late blight fairly well, and suits the double-cropping system. Many attempts have been made in the past and are at present being made to replace Northern Star by other varieties, but no other variety has yet been established as a serious rival. Before the incidence of late blight other varieties, such as Up-to-date, were grown at Pukekohe, but are now found to be unsuitable. Any variety to succeed there must be resistant to late blight and be suitable for double cropping.

Large cut seed, which provides a reserve of plant-feed and gives the young plant a good start, is used for planting the early crop. From this crop small tubers are usually selected for seed for the second crop. These are greened in the sun, and the stem end cut just before planting. Growers contend that cut seed begins growth earlier than uncut seed, and cut seed is almost universally used. The produce from the second crop planted with small seed is usually all sold, and the seed for the early crop is obtained by planting a special area of the second crop with large cut sets. This area is harvested early, and the large tubers are used for planting the following early crop. Some of the seed picked from the second crop is not planted for the early crop, but is "kept over" and planted immediately after the early crop is dug in September and October, to be dug in January and February. The seed from this crop is not saved for further cropping, as its vitality is considered to be lowered by this practice.

Disease and its Control.

The potato-plant being subject to many diseases, it might be expected that the continuous growing of potatoes would result in grave deterioration of the lines used at Pukekohe. The care taken by the growers with their seed, and the practice of digging the crop while the tubers are immature, are primarily responsible for the limited prevalence of virus and other diseases in the crops. There is very little disease evident in the first crop, but wilt diseases show up to a certain extent in the second crop. Epidemics of "mattery eye" have occurred in the past to such an extent that growers fear it more than any other disease. The practice of cutting the seed potatoes, enabling the growers to reject tubers with a discoloured vascular ring, has no doubt helped in reducing the incidence of wilt diseases.

The humid climate is responsible for heavy yearly attacks of late blight, but this disease is usually kept in hand by spraying with bordeaux or burgundy mixtures. Spraying commences when the plants are 3 in. high, and is repeated at ten- or fourteen-day intervals, depending on the weather. Early blight sometimes makes an appearance, but is of no importance.

The potato-moth is fairly prevalent, and is encouraged by the quantity of potatoes left about in the fields every year. The grubs

may cause a certain amount of damage to stored seed, and precautions have to be carried out to prevent the moths laying their eggs on tubers stored for seed from the second crop.

Harvesting and Disposal of Crop.

Prices for early potatoes are highest in the early spring, and in favourable localities growers endeavour to produce crops which can be harvested as early in the spring as possible. The crops, however, cannot be harvested at too young a stage, since the produce will spoil in a few days and have a bad appearance when marketed. The crop can be harvested with safety when the tops are still green but have not reached their maximum growth, and some of the bottom leaves are just beginning to die. At this stage the eyes of the Northern Star (Gamekeeper) potato take on a pink tinge, and many growers judge the time for digging their crop by this sign.

The early crops on the hills are dug by gangs of Maoris, men and women, in charge of a responsible Maori man, who keeps a tally of the work of each digger and makes arrangements for the work and food. The grower usually supplies the food for the gangs while digging is in progress, and deducts the cost from the diggers' wages. The diggers are paid from 9d. to 1s. 6d. per bag, according to the crop and the market price of potatoes. The later crops on the lower flat land are sometimes dug with mechanical diggers, but hand digging is the usual practice.

The potatoes are picked up in two grades, and packed in bags, the full weight of which is 60 lb. Both grades are sold in the case of the very early crop, but later in the season, when the price of second grade falls to the price of seed size, they are kept by the grower for seed for further planting.

The early potatoes are sent all over the North Island, and as far south as Greymouth and Dunedin. The price received for early potatoes in September averages about £30 per ton; it drops rapidly as supplies increase, and by the end of October usually falls to about £18. By the end of November the price has fallen to about £5 a ton and remains at this level till the winter.

Manurial Experiments at Pukekohe.

Summary of Experiments in 1926, 1927, and 1928.

In the early days of potato-growing at Pukekohe, soon after the land was cleared, no manuring was necessary, but after the virgin fertility was exhausted increasing quantities of fertilizers were used. At the present time 15 cwt. to 20 cwt. per acre of mixed fertilizers are used for the early crop, and 10 cwt. to 15 cwt. for the second. Until recently bonedust, dried blood, and nitrogenous guanos were the chief fertilizers used, but now increasing quantities of superphosphate and sulphate of ammonia are being used to replace the more expensive and less efficient bonedust and dried blood.

Experiments in the manuring of potatoes at Pukekohe were started by the Department of Agriculture in 1926, and were continued in 1927, 1928, and 1929. Reports on the earlier experiments were published in this *Journal* for March, 1927, and June, 1928. The object of these

experiments was to measure the usefulness of various phosphatic manures and to ascertain whether bonedust could be economically replaced by a cheaper phosphatic fertilizer.

In the 1926 trials the fertilizers compared were 15 cwt. bonedust, a mixture of 7½ cwt. superphosphate and 7½ cwt. bonedust, and another mixture of 7½ cwt. super and 7½ cwt. Ephos phosphate, per acre. Bonedust contains about 4 per cent. of nitrogen, and sufficient sulphate of ammonia was added to the other phosphatic fertilizer mixtures used in the trial to make up their deficiency in nitrogen. In addition 2 cwt. sulphate of potash was added to each mixture. The results of this trial are given in Table 1, from which it may be seen that bonedust can be quite well replaced by super and Ephos, and that super is probably a more efficient phosphatic fertilizer than bonedust. However, it should be noted that the super and Ephos mixture contained its nitrogen in a water-soluble form, whereas the bonedust contained it in a slower-acting form, and later trials have shown that water-soluble nitrogen is very important in the manuring of the early potato crop.

Table 1.—Summary of Results for 1926, 1927, and 1928.

Year.	Fertilizer.	Yield of Table Potatoes.
		Tons cwt. lb.
1926	15 cwt. bonedust (1)	5 13 101
	7½ cwt. bonedust and 7½ cwt. super (2)	6 6 90
	7½ cwt. Ephos phosphate and 7½ cwt. super (3)	6 9 0
1927	7½ cwt. bonedust and 7½ cwt. super (2)	2 1 49
	7½ cwt. Ephos and 7½ cwt. super (3)	2 4 61
	15 cwt. super (3)	2 5 80
1928	7½ cwt. bonedust and 7½ cwt. super (2)	3 13 2
	7½ cwt. Ephos and 7½ cwt. super (3)	3 13 67
	15 cwt. super (3)	3 15 22
	4¾ cwt. Diammonphos (1)	4 5 45
	7½ cwt. Gafsa phosphate and 7½ cwt. super (3)	3 14 67

(1) Plus 2 cwt. sulphate of potash.
(2) Plus 2 cwt. sulphate of potash and 1⅜ cwt. sulphate of ammonia.
(3) Plus 2 cwt. sulphate of potash and 3½ cwt. sulphate of ammonia.

In 1927 the trials were carried a stage further, and the manurial treatments used were 7½ cwt. bonedust and 7½ cwt. super, 7½ cwt. Ephos and 7½ cwt. of super, and 15 cwt. of super, per acre. Sulphate of ammonia and potash were also added to the mixtures, as in the 1926 trials. The results of these trials are also given in Table 1, and the relative yields were similar to those obtained in 1926. In 1928 these trials were repeated with additional treatments, in which Gafsa replaced Ephos in the mixture and Diammonphos replaced super and sulphate of ammonia. The Diammonphos treatment, when compared with the superphosphate mixture, increased the yield of table potatoes by 10 cwt. per acre. It contained nitrogen to the equivalent of 1·6 cwt. sulphate of ammonia more than the super mixture, but the phosphate content was less by an amount equivalent to 3 cwt. super. These trials indicated that the early potato-crop responded best to water-soluble phosphatic and nitrogenous fertilizers, and that expensive bonedust could be economically replaced by them.

Experiments in 1929.

During 1929 three manurial experiments were carried out with early potatoes at Pukekohe. Experiments were laid down on the farms of Messrs. E. J. Campbell and G. T. Nicholson to determine the value of nitrogen and potash in addition to the basal phosphatic dressing of 15 cwt. super per acre. Another experiment was laid down on Mr. P. A. Miller's farm to determine the effect of different degrees of concentration of manure in proximity to the plant, and whether delaying a portion of the super dressing was beneficial. To ensure accuracy each treatment was replicated ten to sixteen times.

Trial on E. J. Campbell's Farm.

The experimental area on this farm was planted on 30th May, and the crop was dug and weighed on 21st October. The manurial treatments per acre were as follows :—

(1) Superphosphate 15 cwt.
(2) Superphosphate 15 cwt., sulphate of potash 2 cwt., sulphate of ammonia 2 cwt.
(3) Superphosphate 15 cwt., sulphate of potash 2 cwt., sulphate of ammonia 4 cwt.
(4) Superphosphate 15 cwt., sulphate of potash 2 cwt., sulphate of ammonia 6 cwt.
(5) Superphosphate 15 cwt., sulphate of potash 4 cwt., sulphate of ammonia 4 cwt.

Before digging the rows manured most heavily with sulphate of ammonia could be picked out quite easily, the tops being heavier and of a healthy green colour. The yields from the different treatments are given in Table 2, from which it can be seen that the addition of sulphate of ammonia to the basal phosphatic dressing has materially increased the yield. Comparing the yields from treatments 3 and 5 it is evident that increasing the sulphate of potash to 4 cwt. per acre has

FIG. 2. WEIGHING YIELDS FROM EXPERIMENTAL AREA ON MR. CAMPBELL'S FARM, 21/10/29.

decreased the yield below that resulting when only 2 cwt. of potash was used with the same amount of phosphates and nitrogen. The last column in the table gives the per-acre value for the increased yield over treatment 1—the value of the extra manure, extra bags, and cost of digging and carting being deducted from the gross value of the additional table potatoes. The trial clearly indicates the value of sulphate of ammonia as a fertilizer for early potatoes. The high price obtained for early potatoes makes it possible to economically use fairly large quantities of this fertilizer, and in this trial the application of 6 cwt. per acre paid very well.

FIG. 3. PRODUCE OF DIFFERENT MANURIAL TREATMENTS ON MR. CAMPBELL'S FARM.

Left to right: (1) Super, 15 cwt.; (2) super, plus potash 2 cwt. and ammonia sulphate 2 cwt.; (3) super, plus potash 2 cwt. and ammonia sulphate 4 cwt.; (4) super, plus potash 2 cwt. and ammonia sulphate 6 cwt.; (5) super, plus potash 4 cwt. and ammonia sulphate 4 cwt.—all per acre. Photo taken 21/10/29.

Table 2.—Results in E. J. Campbell's Trial.

Treatment.	Yield per Acre.		Increase of First-grade Potatoes over No. 1 Treatment.	Net Value of Increase per Acre over No. 1 Treatment.*
	First Grade.	Second Grade.		
	Tons.	Tons.	Tons.	£ s. d.
(1) Super 15 cwt.	3·02	0·79	..	..
(2) Super 15 cwt., potash 2 cwt., ammonia 2 cwt.	3·91	0·79	0·89	14 0 0
(3) Super 15 cwt., potash 2 cwt., ammonia 4 cwt.	4·65	0·74	1·63	27 0 0
(4) Super 15 cwt., potash 2 cwt., ammonia 6 cwt.	5·11	0·80	2·09	35 0 0
(5) Super 15 cwt., potash 4 cwt., ammonia 4 cwt.	4·30	0·72	1·28	19 0 0

* First-grade potatoes from this crop sold at £23 per ton.

G. T. NICHOLSON'S FARM.

This experiment was planted and manured on 29th May and dug on 25th October. The different treatments were as follows:—

(1) Superphosphate 15 cwt.
(2) Superphosphate 15 cwt., sulphate of potash 2 cwt.
(3) Superphosphate 15 cwt., sulphate of potash 2 cwt., sulphate of ammonia 4 cwt.
(4) Superphosphate 15 cwt., sulphate of ammonia 4 cwt.
(5) Superphosphate 4·6 cwt., sulphate of potash 2 cwt., Diammonphos 4 cwt.

As in the preceding trial the rows which had received nitrogen could be easily picked out before digging. The yields obtained from the different treatments are given in Table 3. Treatments 1 and 2 do not differ significantly from one another; treatments 3, 4, and 5 do not differ significantly from one another, but all are significantly better than treatments 1 and 2. Potash has had no beneficial effect on the yield. The value of sulphate of ammonia in increasing the yield is again demonstrated. Treatment 5 has the same quantity of phosphates, nitrogen, and potash as treatment 3, but part of the phosphate and all the nitrogen is in a different form; there is no significant difference in the yield.

Table 3.—Results in G. T. Nicholson's Trial.

Treatment.	Yield per Acre.		Increase of First-grade Potatoes over No. 1 Treatment.	Net Value of Increase per Acre over No. 1 Treatment.*
	First Grade.	Second Grade.		
	Tons.	Tons.	Tons.	£ s. d.
(1) Super 15 cwt.	4·6	0·52	..	..
(2) Super 15 cwt., potash 2 cwt. ..	4·38	0·54	0·22†	..
(3) Super 15 cwt., potash 2 cwt., ammonia 4 cwt.	5·32	0·51	0·72	8 0 0
(4) Super 15 cwt., ammonia 4 cwt.	5·32	0·55	0·72	9 0 0
(5) Super 4·6 cwt., potash 2 cwt., Diammonphos 4 cwt.	5·22	0·57	0·62	4 0 0

* First-grade potatoes from this group sold at £20 per ton. † Decrease.

FIG. 4. PART OF EXPERIMENTAL PLOT ON MR. NICHOLSON'S FARM.

Left of centre: Rows treated with super 15 cwt., potash 2 cwt., and ammonia sulphate 4 cwt. Right of centre: rows treated with super 15 cwt. and potash 2 cwt.—all per acre. Photo taken 26/8/29.

P. A. MILLER'S FARM.

This third trial was set out to determine whether heavy applications of water-soluble fertilizers in direct contact with the potato sets had any deleterious effect on the initial establishment of the crop. The experimental area was planted on 10th June and dug on 1st November. The crop was manured with a mixture of 15 cwt. superphosphate, 2 cwt. sulphate of potash, and 4 cwt. sulphate of ammonia, per acre, and the fertilizer was applied in the following ways: (1) In a narrow band 3 in. wide, with the potato sets; (2) in a broad band 9 in. to 12 in. wide, with the sets; (3) a mixture of 7 cwt. super, 2 cwt. sulphate of potash, and 4 cwt. sulphate of ammonia in a broad band 9 in. to 12 in. wide, with the sets, and the remaining 8 cwt. of super applied when the crop was up, on 14th September, as a top-dressing.

The yields from the different treatments are shown in Table 4. No. 1 treatment is significantly superior to treatments 2 and 3, which do not differ significantly from one another. No bad effect on establishment of the sets was noticed for No. 1 treatment. Hence the close proximity of the manure to the potato sets was definitely advantageous in this trial.

Table 4.—Results in P. A. Miller's Trial.

Treatment.	Yield per Acre.	
	First Grade.	Second Grade.
	Tons.	Tons.
(1) Manure in narrow band with sets	5·27	0·66
(2) Manure in wide band with sets	4·65	0·63
(3) Part of manure in wide band with sets, and part top-dressed later	4·77	0·65

RECOMMENDATIONS TO PUKEKOHE GROWERS FOR EARLY CROPS.

(1) Use a mixture of 12 cwt. to 15 cwt. superphosphate and 4 cwt. to 6 cwt. sulphate of ammonia, per acre, or

(2) Use 4 cwt. to 6 cwt. Diammonphos per acre. (The respective prices of these fertilizers should determine which is to be used.)

(3) The inclusion of about 2 cwt. potash per acre is an established practice in Franklin County. In the experiments conducted in 1929 potash was of no value in increasing yield, and there was no evidence to show that it conferred other benefits. However, further experimental evidence is required before the Department is prepared to advocate the exclusion of potash, the use of which for potatoes is normally regarded as a good practice.

(4) Do not distribute the manure too widely in the rows; the indications are that it is better to put it in a narrow strip a few inches in width along the row of sets.

NOTE.—It must be clearly understood that these recommendations may be subject to modification as further evidence is gained from experiments.

The writer wishes to record his thanks to Messrs. Nicholson, Miller, and Campbell for their helpful co-operation in carrying out the 1929 manurial experiments.

AN ECONOMIC SURVEY OF DAIRY-FARM GROUPS IN NORTH AUCKLAND, SEASON 1927-28.

E. J. FAWCETT, M.A. (Cambridge), Farm Economist, Department of Agriculture.

Introduction.

IT is intended in two articles to give a short analysis of data from two groups of dairy farms in the North Auckland Land District. The present article deals with sixty-nine farms at Ruawai, in Otamatea County; the second will deal with a group of one hundred and eleven near Dargaville, in Hobson County, which adjoins Otamatea.

In order to facilitate comparisons, the system of analysis employed has been kept uniform with that used in the Department's Bulletin No. 138, "Dairy-farm Management," dealing with Waikato and Taranaki dairy-farms. Figures relative to per-acre production, cows milked per hundred acres, production per cow, area, &c., are tabulated from different angles, each factor being taken as a basis of grouping in turn to show its relative importance compared with other broad management practices. All subsequent tabulations dealing with finance, &c., are shown from one angle only—namely, by grouping data according to butterfat production per acre of productive land. In practically every instance a comparable table will be found for the Waikato and Taranaki farms in Bulletin 138 (which may be obtained free of charge on application to the Department).

The field-work in conjunction with this survey was done by Mr. O. C. Ormerod, of the Department of Agriculture. The manner in which farmers co-operated with him in supplying the necessary data is greatly appreciated by the writer.

GENERAL CONDITIONS PERTAINING TO DAIRY-FARMING IN THE DISTRICTS SURVEYED.

Before going into the detailed analysis of figures it is essential to review some of the main features met with in the area under discussion. The same observations may be taken to apply to both the Ruawai and the Dargaville farms.

The development of dairy-farming on modern lines in North Auckland is a comparatively recent movement, and it cannot be expected that the average position should be strictly comparable with that of old-established dairying centres. The difficulties met with are great and varied, and in some instances are peculiar to this district. For many years development was slow, owing mainly to the system of land-settlement pertaining in districts where kauri-gum has been the main source of income. Improved transport facilities, combined with the demand for land following the war, and, consequent upon price-inflation, the necessity for better exploitation of land, has rapidly altered the position in the last few years.

Land Formation.—Practically all the farms surveyed consist of marine or alluvial deposits with a certain amount of clay and loam, and can be described as all flat country. Drainage is difficult owing to tidal water, and subsidiary drainage is lacking, due mainly to

initial cost. Consequently the land is waterlogged in the winter and early spring, giving a comparatively late spring growth and necessitating the wintering-off of cows in most instances.

Pasture Types and Management.—Conditions are very suitable for the establishment of high-grade pastures under careful management, paspalum, rye-grass, cocksfoot, crested dogstail, white clover, and lotus major being present in most swards. Top-dressing is not so prevalent as could be wished, but is steadily increasing. There is a great amount of speculation as to the advantages of different types of manures, and to the use of fertilizers generally. Subdivision of paddocks and rotational grazing is being recognized as an advantage in pasture and weed control. On strong land of this type, especially where one of the main grasses is paspalum, small paddocks are a necessity if pastures are to be controlled. The movement in top-dressing is probably disturbed owing to abortive results being obtained on many areas badly drained and carrying rank grass-growth. Rushes and pennyroyal are prevalent, and are a cause of restricted production or recurring expense. Tall fescue is a constant menace on many farms, and is responsible for a considerable loss of cattle. It is particularly difficult to eradicate on swamp-land infested with logs and stumps. The Ruawai farms are fairly well provided with shelter-belts, but those of the Dargaville group are lacking in this respect.

Cow Types and Disease.—Dairy stock has been built up to a large extent on a foundation of Shorthorn cattle. At the present time Jersey, Shorthorn, Friesian, and Ayrshire strains are prominent, with a tendency to a predominance of the Jersey. The average cow production is comparatively low throughout the North, doubtless as a result of the foundation stock used. This is gradually being overcome by the introduction of purebred bulls and in some cases heifers or cows of proved production strain, but the movement is retarded owing to the apparent prevalence of disease. It is thought that high-production animals are more susceptible than the hardier heavy types. An outstanding characteristic of the whole of the farms surveyed is the large number of medium-quality cows milked per given area, the underlying principle being that high production may be achieved by heavy carrying, and that if the necessity for culling for disease arises the loss in stock is not so serious as if only high-grade animals were depended upon. It is difficult to compare the incidence of cow-diseases with any other district, but undoubtedly the net replacement factor is of greater moment in Ruawai and Dargaville than is the case in the Waikato.

Wintering-off.—The wet nature of the country makes the wintering of cattle on higher land most desirable, and this practice is common throughout the swamp areas. Partially developed gum-land and hill country adjoin the flats, and this close proximity of the two types of land facilitates the movement of cows. The usual practice is to remove all or part of the herd for a period of eight to ten weeks, the cost varying from 1s. 6d. to 2s. 6d. per head per week. By adopting this method a certain amount of poaching of the ground is avoided and pastures are allowed to come away without interruption, thus ensuring feed for early calvers, and the apparent carrying-capacity of

the farm is high. If it were not possible to winter at least a part of the herd off the farm, production from many swamp holdings would be materially reduced.

Unproductive Land.—A number of the farms have varying areas of unproductive land, but this is not so prevalent in Ruawai as in Dargaville. The average for Ruawai is approximately 4·4 per cent. of the total area occupied. This unproductive area consists mainly of undrained swamp or tall fescue, and affects seventeen farms in the Ruawai group. The area affected has been carefully assessed and has been excluded from all tabulations.

The Climatic Bearing.

As a general rule, the rainfall of the North Auckland Land District is adequate and ideally distributed for the maintenance of permanent pastures in a high state of production at all times of the year. The volcanic land, particularly in Whangarei County, demands constant rain if production is to be maintained, but the swamp type on the West Coast can withstand partial drought conditions without such serious injury. Unfortunately the season under review was a bad one from the distribution viewpoint, although total precipitation was good; in fact, adjacent recording stations showed a total precipitation above the average, although Dargaville, the nearest station to the Ruawai area, shows a slightly subnormal total. Abnormally dry conditions were experienced during November, December, January, and March in Dargaville. With the exception of February, precipitation below the average was experienced from October, 1927, to April, 1928, inclusive. Although it is impossible to gauge the effect of this dry period on the season's production, it is safe to assume that butterfat-yields on all farms were below the average, and this must be kept in mind when studying subsequent tables of results.

The following table gives the total rainfall and its distribution at Dargaville, Whangarei, and Auckland for the year 1927–28.

Month.	Dargaville.			Whangarei.			Auckland.		
	Total Fall.	Number of Wet Days.	Average Rainfall.	Total Fall.	Number of Wet Days.	Average Rainfall.	Total Fall.	Number of Wet Days.	Average Rainfall.
1927.	Inches.		Inches.	Inches.		Inches.	Inches.		Inches.
July	5·91	24	5·12	9·73	21	7·53	8·47	29	4·98
August ..	5·65	24	4·34	6·23	24	6·85	6·96	26	4·19
September ..	4·63	18	3·74	5·97	18	5·03	4·31	21	3·65
October ..	2·78	8	3·76	3·62	7	4·64	2·66	12	3·64
November ..	1·06	12	3·72	1·30	8	3·00	1·63	13	3·26
December ..	1·05	10	2·92	1·34	14	2·49	1·42	12	2·84
1928.									
January ..	0·07	5	2·97	1·52	9	4·08	0·20	3	2·66
February ..	3·46	3	2·99	3·18	6	4·46	1·61	5	3·06
March ..	1·65	9	2·31	6·18	10	4·52	3·45	11	3·03
April	2·65	10	4·04	7·83	13	4·45	4·90	21	3·46
May	8·00	23	6·42	11·73	21	7·84	10·42	30	4·50
June	6·93	21	5·11	12·67	19	6·22	5·84	22	4·91
Total ..	43·84	167	47·44	71·30	170	61·11	51·87	205	44·18

The following notes on the climate of North Auckland are supplied by Mr. C. J. Hamblyn, Instructor in Agriculture, Whangarei :—

A study of the figures giving the average rainfall for the months of December, January, February, and March, for Whangarei, Dargaville, and Kaitaia, over a period of ten years, would indicate that the total fall for each of these months should be adequate for the maintenance of good pasture-growth. The efficiency of this rainfall depends, however, more on the number of days on which rain falls and the distribution of the wet days. A closer study of the rainfall in North Auckland will show that, though the average fall per month during the summer is much the same as that for South Auckland, there are occasional seasons of very little summer rainfall ; but the main point is the fact that the average number of days on which rain falls is about half the number given for South Auckland, and, moreover, the maximum fall for one day is generally much greater. Also, the summer rainfall is made up generally of short spells of heavy rain with long spells of much more intensive heat than elsewhere, so that the rain on a dry soil is not effective, though the total for the month may appear to be so. This applies to the soils of the Northern Wairoa basin, where, in addition, the summer rainfall is on the average a good deal less than that for Whangarei, where thunderstorms are much more prevalent.

These points, I think, have a direct bearing on the known fact that were farmers dependent on English pastures and without paspalum there would be generally a very distinct period of summer shortage of pasture-growth. It is through the use of paspalum, and not on account of the favourable summer rainfall, that pasture-growth is maintained during the summer. With paspalum, in spite of an adequate rainfall, there is a distinct early-spring shortage, but this is overcome on a great many farms by wintering-off and commencing the milking season later than would be the case were rye-grass dominant in the pastures.

1. Ruawai Group—Otamatea County.

Bounded by the Kaipara Harbour on one side, Otamatea County runs across the island to the east coast, and is joined by Rodney County on the southern and by Whangarei and Hobson Counties on the northern boundaries. The greater portion is undulating to hilly, the main dairying districts being on the low country adjoining Kaipara Harbour. Much of the undeveloped country is of the familiar gum-land type. The farms dealt with in this section of the survey are all in the Ruawai district, and represent perhaps the best of the dairying farms in the county.

The total occupied area of Otamatea County in 1928 was 237,615 acres, of which a comparatively small percentage was used exclusively for dairying. Of the area occupied, 159,244 acres were improved, consisting of 155,540 acres in grass, of which 433 acres were cut for hay or ensilage in the season under discussion. Some 2,611 acres were under the plough for cropping purposes, mainly preparatory to establishment of permanent pastures. The remainder represented orchards, plantations, &c. Stock in the county consisted of the following : Horses, 2,339 ; dairy cows in milk or dry, 18,141 ; other cattle and young stock, 24,156 ; sheep wintered, 1928, 74,144 ; pigs, 8,083. On a sheep-unit basis dairy cows represented 36·88 per cent. of the total stock carried.

The sixty-nine farms comprised in this analysis milked 3,102 cows for the 1927–28 season, or 17·1 per cent. of the total dairy cows in the

county. Each farm was visited for the collection of data, and records have been checked in every possible way. A number of records have been discarded owing to incomplete details.

Butterfat Production and Size of Farm.

The following four tables group the sixty-nine farms and present resultant data under the specified headings. It should be noted that all figures within groups have been computed on the unweighted average, and therefore may or may not cross-check.

Table 1.—Farms grouped according to Butterfat-production per Acre (Productive Area).

Butterfat per Acre —Range.	Number of Farms in Group.	Butterfat per Acre.	Butterfat per Cow.	Number of Cows milked per 100 Acres.	Number of Cows milked per Farm.	Productive Area.	Non-productive Area.	Total Area.
lb.		lb.	lb.			Acres.	Acres.	Acres.
160–179·9	5	167·2	241·1	69·7	54·0	76·8	..	76·8
140–159·9	8	147·7	225·3	67·1	50·0	76·5	8·0	84·5
120–139·9	10	129·3	224·5	58·1	50·5	87·4	2·4	89·8
100–119·9	14	108·0	207·4	53·0	48·4	91·3	2·0	93·3
80– 99·9	15	88·3	199·5	44·8	43·1	96·4	3·0	99·4
60– 79·9	9	73·7	184·2	40·6	31·9	75·1	2·1	77·2
40– 59·9	8	49·3	154·1	33·0	39·8	131·3	6·0	137·3

Table 2.—Farms grouped according to Cows milked per 100 Acres (Productive).

Number of Cows milked per 100 Acres—Range.	Number of Farms in Group.	Number of Cows per 100-Acres—Average.	Butterfat per Acre.	Butterfat per Cow.	Number of Cows milked per Farm.	Productive Area.	Unproductive Area.	Total Area.
			lb.	lb.		Acres.	Acres.	Acres.
80–89·9 ..	2	83·4	159·5	192·6	53·0	65·0	18·5	83·5
70–79·9 ..	14	71·9	146·6	204·0	51·3	71·2	5·3	76·5
60–69·9 ..	13	63·9	138·4	216·6	50·3	78·3	2·7	81·0
50–59·9 ..	16	53·5	114·9	214·9	58·4	110·4	2·0	112·4
40–49·9 ..	20	44·5	87·7	192·2	35·6	79·6	1·9	81·5
30–39·9 ..	10	37·0	71·6	193·4	31·3	84·9	1·9	86·8
20–29·9 ..	4	27·1	47·9	176·7	44·8	170·0	12·0	182·0

Table 3.—Farms grouped according to Butterfat-production per Cow.

Butterfat per Cow—Range.	Number of Farms in Group.	Butterfat per Cow—Average.	Butterfat per Acre (Productive).	Number of Cows milked per 100 Acres (Productive).	Number of Cows milked per Farm.	Productive Area.	Unproductive Area.	Total Area.
lb.		lb.	lb.			Acres.	Acres.	Acres.
275–299·9 ..	1	277·8	142·0	51·1	45·0	88·0	12·0	100·0
250–274·9 ..	5	256·3	136·6	53·1	43·8	88·6	..	88·6
225–249·9 ..	14	236·5	120·2	54·7	44·4	80·9	0·0	81·8
200–224·9 ..	19	211·8	114·7	54·0	52·1	95·5	2·1	97·6
175–199·9 ..	16	188·0	77·6	41·2	42·2	108·3	4·8	113·1
150–174·9 ..	8	166·3	99·2	59·7	36·6	64·1	9·8	73·9
125–149·9 ..	6	134·5	59·4	44·1	43·2	98·9	2·0	100·9

Table 1.—Farms grouped according to Size of Farm (Productive Area).

Size of Farm — Range.	Number of Farms in Group.	Productive Area—Average.	Butterfat per Acre.	Butterfat per Cow.	Number of Cows milked per 100 Acres.	Number of Cows milked per Farm.	Unproductive Area.	Total Area.
Acres.		Acres.	lb.	lb.			Acres.	Acres.
30–39·9 ..	2	34·0	120·7	187·8	67·1	22·0	18·5	52·5
40–49·9 ..	5	45·0	76·9	181·3	42·7	19·0	4·6	49·6
50–59·9 ..	13	53·8	110·2	210·8	51·7	27·7	..	53·8
60–69·9 ..	4	64·6	114·7	207·3	54·6	35·3	5·3	69·9
70–79·9 ...	13	73·7	107·4	213·3	50·4	37·1	2·8	76·5
80–89·9 ..	6	84·8	94·7	198·1	47·6	40·3	6·2	91·0
90–99·9 ...	2	94·0	113·6	196·5	57·6	53·5	1·0	95·0
100–109·9 ..	11	101·4	115·6	204·9	55·4	56·1	0·5	101·9
110–139·9 ..	5	124·6	104·1	194·6	51·4	63·4	4·0	128·6
140–199·9 ..	4	160·3	97·7	203·8	48·8	77·5	2·0	162·3
200–299·9 ..	4	258·8	78·3	198·6	38·4	96·8	10·0	268·8

The outstanding feature of the preceding tables is the apparent capability of milking a large number of cows on a given area. The two factors contributing to this are (1) the practice of wintering cows off the farm, and (2) any errors which may have been made in computing the area of land classed as unproductive, an underestimate tending to increase the capacity of productive land. The former reason is the major one, the practice undoubtedly contributing greatly to the success of dairying on swamp flats. Without facilities for wintering-off, this class of land would not be so valuable as at present is the case. Apart from this feature, the tables bear out previous studies and support the contentions made in Bulletin No. 138 relative to the importance of the capacity to milk a larger number of cows on any given area in procuring heavy per-acre production. The area of farms is not apparently correlated with production in this group, this again probably being affected by wintering-off, thus allowing equal per-acre milking-capacity on all sizes of farms under comparable conditions.

Top-dressing and Labour.

The practice of heavy and systematic top-dressing has not yet become general in the Ruawai district. Many farms were not manured at all during the season under review, while many others top-dressed small areas only. Table 5 shows a very different position from that pertaining to the Waikato farms surveyed.

Although more manure is used per acre on the heavier-producing farms, it is apparent that there has not been sufficient applied to greatly influence milking-capacity. The quantity used per cow tends to fall, and any trend in manure used per pound of butterfat produced cannot be regarded as significant. Due to the presence of paspalum in the pasture sward and to the practice of wintering-off, milking-capacity does not show such a wide range of fluctuation as is found on the rye-grass farms of the Waikato and Taranaki districts, where all stock is maintained on the same area all the year. Top-dressing will therefore not show to full advantage in Ruawai till pastures are fully exploited, which should result in a

Table 5.—Manure used for Top-dressing: Farms grouped according to Butterfat-production per Acre (Productive).

Butterfat per Acre—Range.	Amount of Manure.			Lime per Acre (not included in Manure).	Number of Farms in Group.
	Per Acre.	Per Cow.	Per Pound of Butterfat.		
lb.	Cwt.	Cwt.	lb.	Cwt.	
160–179·9	1·6	2·4	1·1	0·1	5
140–159·9	1·7	2·5	1·3	0·2	8
120–139·9	1·4	2·4	1·2	0·2	10
100–199·9	0·9	2·0	0·9	0·6	14
80– 99·9	1·0	2·4	1·4	..	15
60– 79·9	0·9	2·2	1·3	..	9
40– 59·9	0·6	2·0	1·4	..	8

still heavier carrying-capacity and higher herd-averages. An advance in top-dressing will in all probability synchronize with subdivision and with herd-improvement.

Table 6.—Labour: Farms grouped according to Butterfat-production per Acre (Productive).

Butterfat per Acre—Range.	Labour Units per 100 Acres.	Number of Cows milked per Labour Unit.	Butterfat produced per Labour Unit.	Number of Cows milked per 100 Acres.	Number of Farms in Group.
lb.			lb.		
160–179·9.. ..	5·1	15·4	3,681	69·7	5
140–159·9.. ..	4·8	17·2	2,912	67·1	8
120–139·9.. ..	4·4	15·5	3,479	58·1	10
100–119·9.. ..	4·5	13·2	2,673	53·0	14
80– 99·9.. ..	4·1	12·5	2,497	44·8	15
60– 79·9.. ..	4·2	11·3	2,003	40·6	9
40– 59·9.. ..	3·4	11·5	1,756	33·0	8

The labour position illustrates to a great extent the stage of development arrived at on North Auckland dairy farms. A unit of labour represents one person, whether male or female, or children shown as employed whole or part time on the farm. The density of labour is much higher than on farms in a more advanced stage as found in the Waikato or Taranaki. This is due (1) to the heavy carrying-capacity of milking-cows owing to the wintering-off factor previously discussed, and (2) to a wider application of hand milking. The latter condition is being rapidly altered, which will bring the number of cows milked per unit more into line with the figure given in the discussion of Waikato and Taranaki farms. Although the number of cows milked and butterfat produced per unit of labour is at present low, the fact remains that the higher density of labour on high-production groups is utilized to greater advantage than is the case with low-production groups.

Gross Returns.

The gross returns from farms follow very closely the returns from farms of similar production-capacity in other districts, minor fluctuations being caused through profits from pig or cattle accounts.

There is a considerable amount of buying for cow-replacement owing to a heavy wastage from disease, and this has resulted in debit balances in many stock accounts. The total returns are as follow:—

Table 7.—Gross Returns: Farms grouped according to Butterfat-production per Acre (Productive).

Butterfat per Acre—Range.	Gross Returns per 100 Acres.	Number of Cows milked per 100 Acres.	Gross Returns per Cow.
lb.	lb.		£
160–179·9	1,215	69·7	17·43
140–159·9	1,163	67·1	17·33
120–139·9	981	58·1	16·88
100–119·9	804	53·0	15·17
80– 99·9	684	44·8	15·27
60– 79·9	501	40·6	12·34
40– 59·9	377	33·0	11·42

It will be seen that, although total returns are satisfactory, the result has been achieved by milking a greater number of lower-quality cows. This has been made possible by the density of available labour.

Maintenance Expenses.

Expenses of maintenance include two items not experienced in previous surveys—namely, drainage rates and winter grazing. It will be seen that even including these items the total cost per 100 acres or per cow are considerably lower than is the case for farms of similar production in the Waikato and Taranaki districts. This is accounted for by lower expenditure on manures and all the other items except rates. Farms in the Ruawai district are undoubtedly run as economically as possible, but it is questionable whether it would not eventually pay to spend more on the working of the farms if a long view is taken of the position.

Table 8.—Expenses: Farms grouped according to Butterfat-production per Acre (Productive). (All Figures per 100 Acres.)

Butterfat per Acre—Range.	Manure.	Rates.	Fences.	Cultivation.	Power.	Winter Grazing.	Depreciation.	Sundries.	Total.	Cost per Cow milked.
					Actual Cost.					
lb.	£	£	£	£	£	£	£	£	£	£
160–179·9	47·2	53·1	9·3	4·5	26·2	31·6	24·9	23·7	220·5	3·16
140–159·9	48·4	57·1	12·5	13·8	28·5	46·8	28·9	26·4	262·4	3·91
120–139·9	41·6	52·5	9·0	18·3	17·6	30·6	17·9	14·6	202·1	3·48
100–119·9	32·4	47·8	13·9	8·8	17·3	33·6	18·2	16·2	188·2	3·55
80– 99·9	30·3	48·6	7·3	16·5	18·1	23·6	19·5	15·8	179·7	4·01
60– 79·9	24·2	51·3	15·0	10·7	17·8	24·6	19·8	16·1	179·5	4·42
40– 59·9	18·2	41·4	5·2	15·9	10·6	12·3	14·6	11·8	130·0	3·91
					Percentage of Total.					
lb.										
160–179·9	21·4	24·1	4·2	2·0	11·9	14·3	11·3	10·8	100	..
140–159·9	18·4	21·8	4·8	5·2	10·9	17·8	11·0	10·1	100	..
120–139·9	20·6	26·0	4·4	9·1	8·7	15·1	8·9	7·2	100	..
100–119·9	17·2	25·4	7·4	4·7	9·2	17·8	9·7	8·6	100	..
80– 99·9	16·9	27·0	4·1	9·2	10·1	13·1	10·8	8·8	100	..
60– 79·9	13·5	28·6	8·3	6·0	9·9	13·7	11·0	9·0	100	..
40– 59·9	14·0	31·8	4·0	12·2	8·2	9·5	11·2	9·1	100	..

Distribution of Gross Returns.

In Table 9 gross returns are broken up into maintenance expenses, labour reward, and interest surplus. Labour has been charged at £7 per cow milked, in order to effect uniformity with previous analyses. Owing to the heavy milking-capacity of farms in the higher groups particularly, the resultant labour figure appears very high. It must be remembered, however, that milking operations are heavy labour-demanders, and, even though it may be for a part of the year only, adequate help must be available when required if production is to be maintained.

Table 9.—Distribution of Gross Returns: Farms grouped according to Butterfat-production per Acre (Productive).

Butterfat per Acre—Range.	Number of Farms in Group.	Maintenance.		Labour.		Interest.		Total.	
		Per 100 Acres.	Percentage of Total.	Per 100 Acres.	Percentage of Total.	Per 100 Acres.	Percentage of Total.	Per 100 Acres.	Percentage.
lb.		£		£				£	
160–179·9	5	220	18·1	488	40·2	507	41·7	1,215	100
140–159·9	8	263	22·6	469	40·3	431	37·1	1,163	100
120–139·9	10	202	20·6	407	41·5	372	37·9	981	100
100–119·9	14	188	23·4	371	46·1	245	30·5	804	100
80–99·9	15	180	26·3	314	45·9	190	27·8	684	100
60–79·9	9	180	35·9	284	56·7	37	7·4	501	100
40–59·9	8	130	34·5	231	61·3	16	4·2	377	100

This table stresses the fact that it does not pay to run a low-production farm unless production is incidental to the stage of development of the land and shows a progressive increase. Low production and high capitalization are a fatal combination, and even if such farms are not highly capitalized considerable reserve capital is essential for development if the state of production is to be altered in a reasonable period of time.

Interest Surplus.

Accepting the foregoing break-up of income as reasonable, the interest surplus can be converted into capital as a guide to the production-value of land under the conditions experienced in this district.

Table 10.—Interest Surplus and Capital: Farms arranged according to Butterfat-production per Acre (Productive).

Butterfat per Acre—Range.	Number of Farms in Group.	Number of Cows milked per 100 Acres.	Interest Surplus per 100 Acres.	Gross Capital represented at 7 per Cent.
lb.			£	£
160–179·9 ..	5	69·7	507	7,240
140–159·9 ..	8	67·1	431	6,164
120–139·9 ..	10	58·1	372	5,319
100–119·9 ..	14	53·0	245	3,493
80– 99·9 ..	15	44·8	190	2,719
60– 79·9 ..	9	40·6	37	535
40– 59·9 ..	8	33·0	16	223

Gross capital covers land and improvements, stock and plant. Therefore if the value of stock and land is subtracted one arrives at a figure on which the average farm in this district earns 7 per cent. interest after paying maintenance expenses and a labour reward on the basis of £7 per cow milked.

Table 11.—Capital Position: Farms grouped according to Butterfat-production per Acre (Productive).

Butterfat per Acre—Range.	Number of Farms in Group.	Number of Cows milked per 100 Acres.	Gross Capital.	Valuation of Stock and Plant.	Net Capital—Land and Improvements.	Value of Land and Improvements per Cow milked.
lb.			£	£	£	£
160–179·9	5	69·7	7,240	1,178	6,062	86·97
140–159·9	8	67·1	6,164	1,220	4,944	73·68
120–139·9	10	58·1	5,319	945	4,374	75·28
100–119·9	14	53·0	3,493	901	2,592	48·91
80– 99·9	15	44·8	2,719	830	1,889	42·17
60– 79·9	9	40·6	535	806	— 271	..
40– 59·9	8	33·0	223	629	— 406	..

Those groups of farms having a high average production are earning on a per-acre capital basis quite comparable with that of farms in older-established districts, but they are doing so by milking a large number of cows, which reduces the capital value per cow milked. The falling-off is very rapid in low-production groups.

It is of interest to compare the capital value, as assessed above, with Government valuations. As is to be expected, these valuations are below the apparent earning-value on high-production farms, but on farms producing below 120 lb. of butterfat per acre they are considerably above. The variations in management efficiency and in farm improvements make it very difficult to assess a fair valuation for taxation purposes.

Table 12.—Valuations: Farms grouped according to Butterfat-production per Acre (Productive).

Butterfat per Acre—Range.	Number of Farms in Group.	Value of Land and Improvements per 100 Acres.	Government Valuation per 100 Acres.
lb.		£	£
160–179·9 ..	5	6,062	3,826
140–159·9 ..	8	4,944	4,263
120–139·9 ..	10	4,374	3,752*
100–119·9 ..	14	2,592	3,493†
80– 99·9 ..	15	1,889	3,459
60– 79·9 ..	9	— 271	3,419
40– 59·9 ..	8	— 406	2,960

* Eight farms. † Twelve farms.

SUMMARY.

Dairying in the Ruawai district has developed along lines suited to conditions prevailing locally. Owing to the swampy nature of the country and availability of hill country adjoining, wintering-off occupies an important place in herd and pasture management. Owing to the

type of foundation stock used, and to the prevalence of disease, the average production per herd is not high, but is steadily improving. Wintering-off has enabled farmers to practise a heavy density of cows during the lactation period, and this system of management has resulted in heavy per-acre production on the more highly improved farms. Total returns are comparable with old-established farms in other districts; but this has been attained at the expense of labour. In other words, more labour is required to achieve the same capital result than is the case in Taranaki and the Waikato, where, owing to a higher production per cow, a lesser number gives the same butterfat total.

The fact that so many of the farms show a sound financial position is evidence that those at present below the average can be looked upon as potentially sound. Lack of capital is undoubtedly the major retarding factor, although misfortune has played its part on many holdings. Again, it must be remembered that the district suffered from a dry summer during the season under review.

(To be continued.)

FEEDING ENSILAGE TO SHEEP.

SOME SUCCESSFUL EXPERIENCES BY FARMERS.

MANY hundreds of New Zealand farmers are successfully and profitably feeding ensilage to dairy cows. This fact is prompting numbers to ask whether it is advisable to feed ensilage to sheep. Much light will be thrown on this matter by relating what had already been the experience in New Zealand of certain farmers who have fed ensilage to sheep.

South Island Experience.

Mr. C. V. Dayus, District Superintendent, Live-stock Division, Dunedin, gives the following particulars:—

Otautau.—Mr. R. Greenslade, of the Otautau district, Southland, fed oats and peas ensilage, at the rate of about 2 lb. daily, to sheep during the winter of 1929. The sheep did well, and Mr. Greenslade intends to continue using ensilage in this manner.

Queenstown.—Messrs. H. McKenzie and Sons, of the Queenstown district, also fed ensilage to hoggets during last winter. They are of the opinion that the hoggets did much better on it than other sheep did on hay, and they intend to make more ensilage in future.

Myross Bush. Mr. H. C. Stevens, Myross Bush, near Invercargill, fed ensilage to 400 sheep during last winter, and intends to increase his ensilage supplies.

In respect to Mr. Steven's experience, Mr. G. W. Wild, of the Fields Division, Invercargill, reports as follows: In July it was decided to commence feeding out the ensilage. This proved to be of an excellent sweet green type from top to bottom. A mob of 400 in-lamb ewes had been selected for feeding. A timely fall of snow proved most opportune, as the ensilage, when thrown along the gorse hedge, was

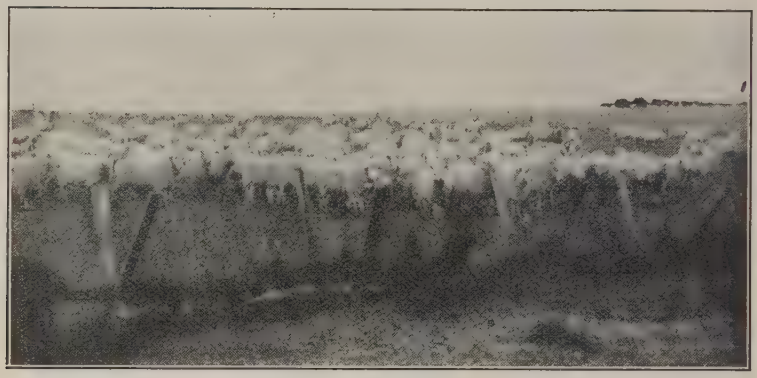

FIG. 1. SHEEP ON MR. STEVENS'S FARM, MYROSS BUSH, WAITING FOR ENSILAGE.
The rack seen in foreground had been filled the previous day.

FIG. 2. SHEEP FEEDING ON THE ENSILAGE.
Note that the left end of the rack, containing hay, is receiving no attention.

FIG. 3. EWES SHOWING KEENNESS FOR GOOD, SWEET, GREEN ENSILAGE.
[Photos by G. W. Wild.

quickly sampled and found palatable by the hungry ewes. Hoggets showed less inclination to take readily to the ensilage at the start, but this soon changed to wholesale liking. A V-shaped hay-rack constructed of wire netting was next erected. It was decided to use half of this rack for hay and half for ensilage, the total length being approximately a chain. About 2 lb. of ensilage per ewe was allowed each day. The ewes showed decided preference for the ensilage. Mr. Stevens's opinion of the results he obtained with the ensilage may be judged from the fact that this season he has saved some 140 tons of grass ensilage in place of the 80 tons saved in the preceding year.

Mr. J. Kerrigan, District Superintendent, Live-stock Division, Christchurch, advises :—

South Canterbury.—Mr. Allen, of the Mackenzie County, who fed ensilage to hoggets, is of the opinion that they ate it readily and did very well on it.

North Island Experience.

Mr. W. C. Barry, District Superintendent, Live-stock Division, Wellington, forwards the following notes :—

Hastings.—Messrs. Thompson Bros., of Ngatarawa, Hastings district, have fed considerable quantities of ensilage to their sheep, and are of opinion that by doing so they have practically doubled the carrying-capacity of the farm. Mr. Thompson, who supplied the information, does not claim that he can fatten sheep by feeding them on ensilage, but considers that it tends to keep them in good health. He thinks there has been less "bearing" trouble among the breeding-ewes since feeding with ensilage, and that the quality of the wool has improved. Ensilage from one pit fed 2,500 sheep from April to October. Mr. Thompson says the taste for ensilage by sheep is what might be termed an acquired one, but that once sheep have acquired it they come readily whenever they see the daily supply of ensilage arriving.

Karioi.—Mr. Black, of Karioi, Raetihi district, has been feeding 1,500 ewes on ensilage placed in racks situated in the run-off paddock from turnips. He states that the ewes do much better on it than when he was feeding hay with the turnips.

Taranaki.—In this district Mr. A. Turnbull has fed ensilage to sheep for several years, and states that slight digestive disorders have been experienced occasionally when feeding it to in-lamb ewes; in such cases has had to discontinue feeding it for short periods. Mr. Turnbull and another Taranaki farmer who has been feeding ensilage to sheep agree that it is necessary to have ordinary grazing for the sheep as well, the ensilage alone not being satisfactory.

Feilding.—Investigation of the experience of Mr. A. S. Brewster, Makino, Feilding, by Mr. R. P. Connell, of the Fields Division, disclosed the following most instructive results: Mr. Brewster wintered on his farm, which is devoted wholly to sheep, 1,110 four- to five-year-old crossbred Romney ewes. Up to docking-time there were thirty-one ewes lost by death. The lambs tailed represented 104 per cent. of all ewes wintered. Lambing difficulties did not at all show any unusual features. The wool obtained this season averaged 9½ lb. per ewe, and was of good quality and not characterized by breaks. The sales of fat lambs were the most striking feature of the farm. The

fat lambs sold from the flock up to 23rd December last represented 71 per cent. of the lambs reared. A number of these lambs were sold early for butcher's use, and the weights of these were not ascertained, but the main draft averaged 38·8 lb. The previous season's lambs from this farm averaged 37·7 lb. According to the estimates of leading local buyers for freezing companies, farms of similar good character to Mr. Brewster's were, on the average, disposing of about 50 per cent. of their lambs as fats prior to Christmas, compared with Mr. Brewster's 71 per cent. Further, whereas generally the lambs drafted as fat were, on the average, 3 lb. to 5 lb. down in weight compared with the lambs from the same farms in the previous season, Mr. Brewster's lambs were 1 lb. up in weight. Hence, Mr. Brewster's results this season stand out both in respect to weight of lambs and relative numbers sold. During June and July and right up to lambing-time Mr. Brewster fed ensilage to the ewes at the rate of about 2 lb. daily. He considers ewes should be in good condition when first they are offered ensilage, as he found it necessary to practically starve them for some days before they could be forced to commence eating it, although once they made a start they continued consuming it quite readily, with the exception of a small number, which therefore were drafted out and attended to otherwise. In feeding the ensilage to the ewes prior to lambing, Mr. Brewster ran them in lots of 400 at the rate of approximately 14 ewes to the acre. As the ewes lambed they were drafted into paddocks of fresh grass, which had been spelled for some of the time the ensilage was being fed. In mid-September Mr. Brewster's lambs were inspected, and then were very forward in comparison with others in the district. It would seem that the ensilage fed to the ewes acted in a twofold way: (1) The lambs were born in better condition and stronger than they would have been had the ewes been without ensilage; (2) the ewes were in better condition at lambing, and hence milked better after lambing. Mr. Brewster says of ensilage feeding to sheep: "It seems to me one of the coming methods of wintering a large number of ewes on a small acreage successfully. I shall be wintering my ewes on ensilage again this year."

Waverley.—Mr. F. G. Ell, manager of Dr. Paget's farm at Waverley, courteously supplied details of his experience to the Director of the Fields Division. Mr Ell, who has been feeding ensilage to sheep for four years, commences feeding it in June and continues it until the end of September. He had some difficulty in getting the sheep started on it the first year. His method is to graze a couple of paddocks very hard with cattle, he then puts a flock of 1,000 ewes in one paddock and feeds out a ton of ensilage. In the other paddock he feeds out 1 ton of hay and about 2 tons of carrots, and then changes the ewes from one paddock to the other every second day or so for about a month. He always feeds ensilage in combination with hay or carrots. He estimates that the ewes consume about 2 lb. of ensilage daily. The average mortality among the ewes for the past four years was 1½ per cent., and the average wool clip 9 lb. The lambing percentages for the past four years were 101 in 1926, 109 in 1927, 117 in 1928, and 105 in 1929.

Rotorua.—At the Prison Farm in the Rotorua district ewes were fed on grass and clover ensilage from the end of June to September. At first the ewes ate little of the ensilage, but after a week or so they looked for it.

Summary.

From the foregoing record of the experience and opinions it is clear that ensilage is being fed successfully to sheep in various parts of New Zealand by a number of farmers. Points brought out in the experiences related may be summarized as follows:—

(1) Sheep, as might be expected, being shy, nervous animals, do not immediately consume a strange fodder such as ensilage, but once having become accustomed to it they consume it readily. Probably one of the best methods of inducing sheep to commence eating ensilage is to stock a relatively bare paddock heavily—at the rate of fifteen sheep or so to the acre and then feed out the ensilage. After the first season of feeding there will usually be on hand sheep from the previous season which have consumed ensilage and which will act as leaders in eating it to those sheep to which it is being fed for the first time.

(2) Successful experience with ensilage has usually been the feeding of relatively small amounts daily—about 2 lb.—in conjunction with other forage. The experience does not disclose definitely whether larger amounts of ensilage could be fed with profit and without any danger of trouble, but until it has been shown what quantities can be fed to in-lamb ewes with safety it will be well for farmers giving the method a trial to feed not more than 3 lb. per ewe daily.

The Department of Agriculture will be glad to receive details of the experience of any other farmers who have been feeding ensilage to sheep.

—*Fields Division.*

STATISTICS OF IRRIGATED LANDS IN NEW ZEALAND.

Utilization of Irrigated Lands.	Area irrigated.	
	Year 1927–28.	Year 1928–29.
	Acres.	Acres.
Orchards	2,244	2,032
Green fodder and root crops	3,099	2,985
Pasture	50,201	53,104
Lucerne	1,290	1,061
Oats	316	365
Wheat	60	106
Barley	16	159
Market gardens	6	19
Other crops	8	14
Totals	57,240	59,845

—*Census and Statistics Office.*

THE CANARY GRASSES IN NEW ZEALAND.

H. H. Allan and V. D. Zotov, Plant Research Station, Palmerston North.

Of recent years interest has been aroused in New Zealand concerning "Harding Grass" and its relation to "Toowoomba Canary-grass" and "Phalaris bulbosa." Kennedy*, writing in 1917, stated: "That much, if not all, of the seed of *Phalaris* now on the markets of New Zealand and Australia is hopelessly mixed seems to be certain; and also that a selection of the perennial species will have to be made before one can recommend the purchase of seed from these countries." He instances the fact that a sack of seed exhibited by the New Zealand Government at the Panama International Exposition, and labelled "*Phalaris bulbosa*," proved on sowing to be "an annual and not the desirable perennial grass called *Phalaris bulbosa* as received from South Africa."

The Director of the Plant Research Station asked us, therefore, to look into the matter of the systematics of the species of *Phalaris* found in New Zealand, whether as naturalized plants or as purposely sown. It was soon found that the synonymy of *Phalaris* species was much involved, especially as regards "*Phalaris bulbosa*." To make the situation clear, so far as it affects New Zealand, it is necessary for us to go somewhat into the history of the matter. We are greatly indebted to the Director of the Royal Botanic Gardens, Kew, for allowing Mr. C. E. Hubbard to devote much time to elucidating certain problems that we put to him. Without Mr. Hubbard's thorough and detailed report, and a series of authentically named specimens forwarded by him, we could not have arrived at definite decisions. We have also to thank the following gentlemen for very kindly forwarding information and specimens: Professor Dr. A. Béguinot, University of Modena; Professor P. B. Kennedy, University of California; Professor Dr. G. E. Mattei, University of Messina; Mr. F. J. Rae, Government Botanist for Victoria; Mr. C. T. White, Government Botanist for Queensland; and Mr. J. W. Whittet, Agrostologist, Department of Agriculture, New South Wales.

Origin of Toowoomba Canary-grass.

There are two conflicting accounts of the introduction of this grass into Australia. R. R. Harding (as cited by Kennedy, *loc. cit.*, p. 2) says: "In 1883 I received twenty-one packets of seed from Italy. These I put in the nursery. All germinated, but the frost killed all except this wonderful grass, *Phalaris commutata*. In two years it had taken possession of nearly the whole plot of ground in the nursery from the seed self-sown. It is a perennial. We had to remove the grass, so we dumped the root-clumps in a corner on hard ground, but it still grew to 5 ft. in height. This was during the drouth and frost, and although it was cut it grew again." Ewart (*Journ. Dept. Agric., Victoria*, Vol. 6, 1908, pp. 738–740) says: "Mr. Charles Ross, Manager of the State Farm, Westbrook, Queensland, however, informs

* "New Grasses for California: I. *Phalaris stenoptera* Hack." Univ. of Calif. Publications in Agric. Science, Vol. 3, No. 1, pp. 1–24, July 13, 1917.

me that it was introduced into Toowoomba over twenty years ago, when the late Mr. Way was Curator of the Botanic Gardens. The seed was received with about sixty other grasses from the Agricultural Department of New York, U.S.A. All the varieties were lost but this one, which existed in out-of-the-way places, such as hedgerows and rubbish-heaps." Ross at once began to progagate and distribute it. Harding also distributed it to all the colonies, Africa, and even Italy. Ewart suggests a third explanation: "We have no guarantee that the seed originally imported was pure, or, in fact, that the plant with which we are dealing was actually derived from imported seed at all. The gap of four or five years between the apparent loss of the seed and the reappearance of the plant on a rubbish-heap is a big one, and gives room to many possibilities." He suggests it may have been a hybrid between *P. arundinacea* and *P. canariensis*. It certainly seems possible that the grass actually propagated and distributed was an accidental introduction, and was not derived from the sowings of either Ross or Harding.

What is Toowoomba Canary-grass?

How the name *P. commutata* came to be applied to the Toowoomba grass remains obscure. *P. commutata* Roem. et Schult. was a name given to specimens collected in northern Italy. It seems certain that the species was based on the rhizome and leafy stems of *P. nodosa* Murp. (which is *P. tuberosa* L.), and an inflorescence of *P. minor* Retz. The name *commutata* has therefore been abandoned by taxonomists for any species of *Phalaris*. Ewart sent specimens of the Toowoomba grass to the Director of Kew and to Hackel, then the greatest European agrostologist. Hackel decided that he had a new species, the country of origin of which was unknown, and named it *P. stenoptera*, on account of the narrowness of the wings. He places it as intermediate between *P. bulbosa* and *P. arundinacea*. Hackel's description (in Fedde, *Rep. Nov. Spec. Regni Veg.*, Vol. 5, 1908, p. 333) includes the following points in which his *stenoptera* is held to be distinct from *bulbosa*: (1) the the narrower wings, (2) basal internodes not swollen, and especially (3) absence of the first sterile floret, with the second 1 mm. long.

Stapf reported of the specimens sent to Kew that they belonged to *P. bulbosa* L., the narrowness of the wings being attributed to the fact that the inflorescences sent were immature. He says (*Kew Bull.*, Vol. 37, 1909, p. 291) of later specimens, "The samples communicated by Mr. Maiden and Mr. Hedley Wood are fully developed and certainly confirm the determination of the grass as *P. bulbosa*. They differ from the typical Mediterranean plant known under that name in nothing but the stouter stems and altogether more luxuriant growth, and the obscure but still noticeable swelling of the basal internodes, a character to which the grass owes its name. The plant is, however, able to adapt itself to a great variety of external conditions, and the development of the vegetative parts varies accordingly. Fairly luxuriant specimens with slightly swollen basal internodes are extant in the Kew collections from Algeria, representing a strain such as might have given rise to the luxuriant Toowoomba race." As to the spikelets, Stapf says, "The condition and number of the 'sterile glumes' in the Toowoomba grass is, however, exactly the same as in *P. bulbosa*. . . [the first sterile

floret] is represented by a small cartilaginous scale with a tiny membranous appendage; [the second] by a similar slightly larger scale with a linear-subulate appendage, which reaches up to $\frac{1}{3}$ or almost $\frac{2}{3}$ of the last glume which is fertile."

Kennedy (*loc. cit.*, pp. 3–5) after comparing his specimens, apparently derived from seed from South Africa, with the "original" description of *P. bulbosa* concluded that they could not be referred to that species. Unfortunately he does not state what "original" description he had used. Assuming that it was the description of Linnæus, it will be seen from what follows that one can well understand why Kennedy could not accept it as treating of the Toowoomba grass. He decided that Hackel's "excellent detailed description" of *P. stenoptera* "agrees with our grass from South Africa in everything but the sterile florets." As to these, his statements agree pretty well with those quoted from Stapf. Kennedy therefore accepts Hackel's name, and suggests the popular name "Harding Grass" in place of the unwieldy "Toowoomba Grass." But Hackel's statement concerning the sterile florets of his specimens is the crucial point in the differentiation between *P. stenoptera* and *P. bulbosa*, and if this is so far from the truth his species appears to fall to the ground. As an explanation of the difficulty, Kennedy offers this suggestion: "Hackel mentions that he received the plants and seeds from which he drew up the original description of *Ph. stenoptera* from A. J. Ewart, of Melbourne. Since the seeds of at least two species are so hopelessly mixed in Australia, is it not just possible that the seeds sent to Hackel may have been the annual species, which constantly has only one sterile floret, and that the plants were those of *Ph. stenoptera*, the perennial species?" So experienced a taxonomist as Hackel is most unlikely to have missed the actual facts concerning the specimens in front of him, and Kennedy's suggestion provides a very possible explanation. But, if it be the true one, *P. stenoptera* becomes a case identical with *P. commutata*, and the name should be abandoned. Kennedy also suggests, as Ewart had done, the possibility of a hybrid origin for Toowoomba grass.

We have examined material collected in various parts of New Zealand, and have compared it with specimens from Australia. Among these we have a sheet collected by Charles Ross on the Reformatory Farm at Westbrook, and one collected by J. Liverseed on the State Farm, Hermitage, near Warwick. This last specimen is a duplicate of material examined by Stapf. We have also specimens from Sicily and the Island of Rhodes. We have also grown specimens from seed collected in New Zealand, and from seed kindly supplied by Mr. Kennedy. We have seen plots also grown from seed originating with Mr. Kennedy. Our findings agree with those of Stapf, and we consider Toowoomba grass (Harding grass) and the European grass generally referred to as *Phalaris bulbosa* to be one and the same species. Both in specimens from New Zealand and from American seed there are slight differences in individual plants as to degree of robustness and development of the basal swellings, but we do not find swellings altogether absent. Conditions of growth and cultivation naturally have considerable influence on the development of the plants. Older plants from long-established pastures have a greater tendency to rhizome-development and to swelling of the basal internodes. We do not wish to deny that in Toowoomba grass there may be more than one distinct race, with

possibly distinct agricultural values. Indeed, we think it quite likely that intensive study would reveal such races, but that even then botanically they should be treated as at most varieties of a single species. The hybrid idea was attractive to us, but we have seen nothing that in any way supports it. Nor have we observed hybrids with *P. minor*.

What is Phalaris bulbosa?

In the foregoing we have used the name *bulbosa* as for the grass of the Mediterranean region. This is the sense in which it is used by Stapf and Hackel, and by the generality of European taxonomists, whether with or without the name of Linnæus attached. But there is grave doubt whether the name *bulbosa*, as thus used, applies to the grass originally described by Linnæus. The synonymy is complicated, and we propose merely to give what appear to be the essential facts that emerge, following Mr. Hubbard's researches.

P. bulbosa L., *Cent. Pl.* i, 4 (1755); *Amoen. Acad.* IV, 264 (1759). This is the earliest and only valid use of the name *bulbosa*. The specimen in the Linnean Herbarium named *P. bulbosa* in the handwriting of Linnæus is the plant now known as *Phleum tenue* Schrad., and not a *Phalaris*. To this specimen the description of Linnæus applies much better than to the Mediterranean *Phalaris*, and the statement of distribution, "in Oriente," also agrees with *Phleum tenue* and not with the *Phalaris*. The name *bulbosa* should therefore be abandoned. Linnæus described the Mediterranean plant under the name *P. tuberosa* in *Mant.* ii, 557 (1771). The species is based on the description by Morison of his "Phalaris perennis maior radice nodosa" in *Plant. Hist. Oxoniensis*, iii, 187 (1699). There is a specimen so named in the Linnean Herbarium. This is the species to which the name *bulbosa* has commonly been applied. The name *P. aquatica* L. has also to be considered. It is by no means clear whether this name is to be applied to *P. tuberosa* L. or to *P. caerulescens* Desf. Added to this is the fact that the terms *bulbosa* and *aquatica* have both been applied as specific epithets by different authors to a number of different species (both, for example, have been used for *Phalaris minor* Retz.). The clear and legitimate solution of the tangle appears to be to reject both *aquatica* and *bulbosa*, as being "nomina confusa." This leaves us free to adopt the name *P. tuberosa* for the species we are considering, to which alone it has been applied.

Species of Phalaris occurring in New Zealand.

We supply a key to the species we have observed in New Zealand, and add remarks on each. The following notes, together with the illustrations, will enable the uninitiated to understand the terms used. The flowers are developed in panicles of spikelets, each spikelet being stalked. The panicles may be arranged with the branches somewhat widely spreading (as in *P. arundinacea*, Fig. 1, *a*), or closely compacted, the whole inflorescence then having a spikelike appearance (Figs. 1, *b*, *c*, *d*, *e*). Each spikelet is composed of the following parts: Two large husks (glumes) enclosing the florets (Figs. 2, *a–e*); a fertile floret with hardened, rather shining, more or less hairy husks (Figs. 2, *f m*); one or two sterile florets at the base of the fertile one, composed of small shining scales with or without an appendage (Figs. 2, *f*, *g*, *l*).

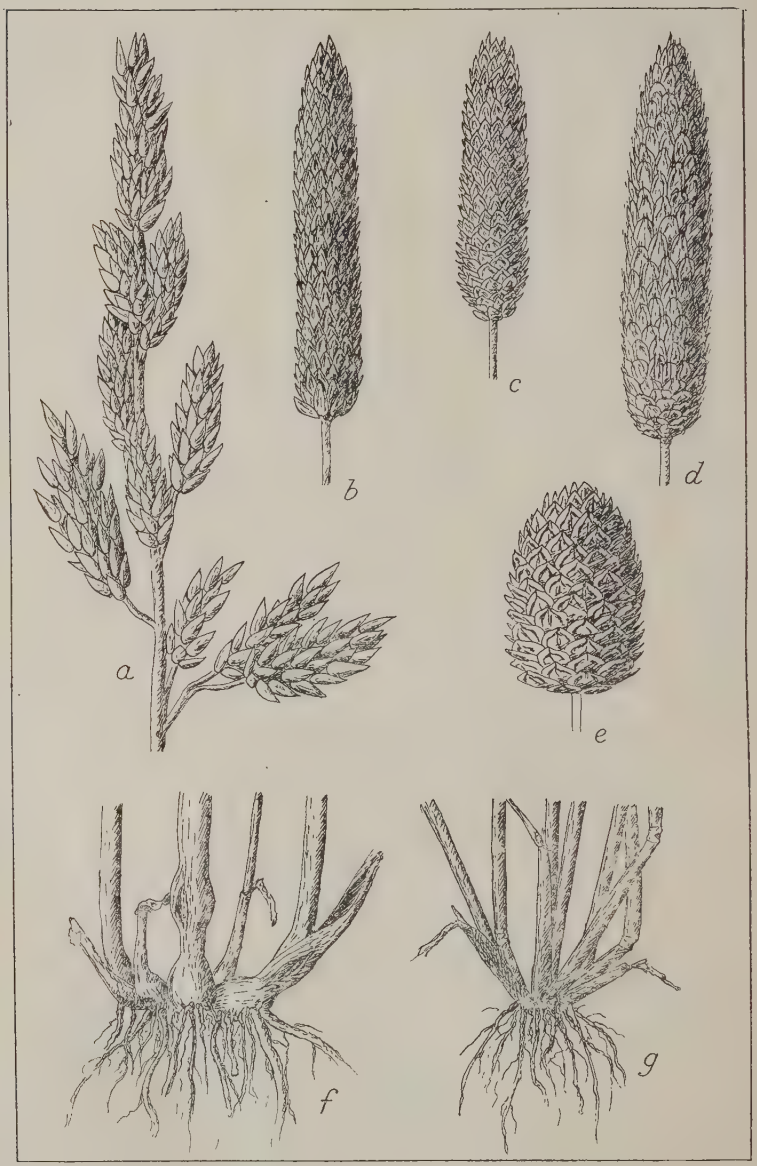

FIG. 1. DISTINGUISHING FEATURES OF VARIOUS PHALARIS SPECIES.

Panicles of (*a*) *P. arundinacea*, (*b*) *P. tuberosa*, (*c*) *P. minor*, (*d*) *P. caerulescens*, (*e*) *P. canariensis*. Stem bases of (*f*) *P. tuberosa*, (*g*) *P. minor*.

FIG. 2. OTHER DISTINGUISHING FEATURES OF PHALARIS.

Glumes of (*a*) *P. arundinacea*, (*b*) *P. tuberosa*, (*c*) *P. caerulescens*, (*d*) *P. minor*, (*e*) *P. canariensis*. "Seeds" of (*f*) *P. arundinacea*, (*g*) *P. tuberosa* (Kennedy's seed), (*h*) *P. tuberosa* (Craw's seed), (*j*) *P. minor* (light seed), (*k*) *P. caerulescens*, (*l*) *P. canariensis*, (*m*) *P. minor* (dark seed).

Each glume is sharply folded in half, thus producing a "keel" at the midrib. This keel is more or less (strikingly so in *P. canariensis*) produced into a thin winglike expansion (Fig. 2, *e*). In *P. canariensis* the sterile florets are well developed, extending half the length of the fertile floret (Fig. 2, *l*); in *P. tuberosa* they are much less developed, and the first may be quite rudimentary (Fig. 2, *g*); in *P. minor* the first is reduced to a minute scale, and the second is about one-third the length of the fertile floret (Fig. 2, *j*, *m*).

1. Panicle with distinctly spreading main branches .. .. *arundinacea.*
   Panicle dense spikelike 2
2. Perennials with short thickened root-stock, more or less basal swellings on stems (Fig. 1, *f*) 3
   Annuals lacking short thickened root-stock, not swollen at base of stems (Fig. 1, *g*) 4
3. Glumes acuminate; wings distinctly toothed .. .. .. *caerulescens.*
   Glumes ovate, blunter; wings not distinctly toothed .. .. *tuberosa.*
4. Panicle oblong, sterile floret ½ length of fertile .. .. .. *minor*
   Panicle short, broad; two distinct sterile florets .. .. *canariensis.*

P. arundinacea L. (Reed Canary-grass): A plant of damp ground. Native to South Europe and North Africa. This species is easily recognized by the spreading panicle and the practically unwinged glumes. It was first recorded in New Zealand by T. Kirk for Wellington—"by a tributary of the Waiwetu, probably planted"—in 1878. This was the variegated variety, *picta*, known in gardens as "ribbon-grass." The typical form has been observed by the Waikato River near Mercer, and by the Manawatu River near Foxton. It is of no moment agriculturally.

P. caerulescens Desf.: A native of the Mediterranean region. This resembles *P. tuberosa* in habit, but has the glumes distinctly drawn out into acuminate tips. It does not occur wild in New Zealand, but has occasionally been grown on experimental farms. The name has sometimes been mistakenly applied to *P. tuberosa*.

P. canariensis L. (Canary-grass): A native of the Canary Islands. This is a common ingredient of "canary seed." The grass is easily recognized by the short broad heads, the broad wings to the glumes marked with green lines, the comparatively large fertile florets, with a prominent sterile pair at the base. It is one of the earliest recorded naturalized plants of New Zealand, having been listed by Forster in his "*Prodromus*" of 1786. Allan Cunningham in his "*Precursor*" of 1836 remarks of it: "Summit of hills cleared by the natives. Bay of Islands and its vicinity.—1826, A. Cunningham (Middle Island)—1773, G. Forster." Cheeseman (*Man. N.Z. Flora*, 1925, p. 1055) records it for both islands in "fields and waste places, abundant." We, however, have only occasionally come across it in waste places, and consider it by no means abundant as a naturalized plant. Probably the next species has often been confused with it. *P. canariensis* is insignificant as a weed in New Zealand, and is purely an annual.

P. minor Retz. (Lesser Canary-grass): A native of Europe and Western Asia. This annual species is easily distinguishable from *P. canariensis*. The heads are longer and more cylindric, the glumes are distinctly pointed and bear much narrower wings, which are more or less toothed in the upper portion. Only one sterile floret is developed, and attains to one-third of the length of the fertile floret. This has not

before been recorded as naturalized in New Zealand, having probably been passed over as *P. canariensis*. It has sometimes been called *P. paradoxa*, but differs very markedly from that peculiar species, which we have not observed in New Zealand, though it is to be met with in Australia. We have noted *P. minor* in waste places in numerous localities in North Island and in the northern part of South Island. It has occasionally been grown as a crop under the misapprehension that it was Toowoomba grass, and seed has been harvested and sold as that species. The same thing has apparently occurred in Australia. The samples of recently harvested Toowoomba grass that we have seen have, however, been free from this species.

Mr. N. R. Foy, Seed Analyst of this Station, separated out *Phalaris* seed from dressings of white clover into two lots—"pale" seed and "dark" seed. Both samples produced *P. minor*, the plants from the pale seed being rather more robust. Seed gathered from the plants of each lot was predominantly "dark" (Fig. 2, *m*). Ripe seed gathered from plants in waste places we have always noted to be predominantly or purely "dark," and this dark colour appears to be a good character of the strain occurring in New Zealand at any rate. Seed of *P. minor* has been noted in samples of lucerne and red-clover seed from Italian sources.

P. tuberosa L. (Toowoomba Grass; Harding Grass): A native of the Mediterranean. This is a perennial grass of valuable characteristics. It is distinguishable from *P. caerulescens*, the other perennial species bearing short rhizomes and basal swellings to the stems, by the glumes not being acuminate-pointed nor distinctly toothed. The sterile floret of *P. caerulescens* are still smaller and quite glabrous, whereas in *P. tuberosa* they usually show some hairs at least. It has been grown in experimental plots in New Zealand on numerous occasions. Sown on the plots of the Earnscleugh Run in Central Otago, in 1914, by Mr. A. Macpherson, under the name *P. bulbosa*, it was still persisting and vigorous there in 1928. An area of some 50 acres was established at Linton by Mr. D. Craw many years ago, and produced an excellent stand. Mr. Craw has taken off numerous crops of seed of excellent quality. The plant has escaped from this area on to adjacent roadsides, and we have also noticed it as naturalized in waste places about Palmerston North.

The "Seeds" of P. minor and P. tuberosa.

As it is important to distinguish these, some further details are given. Seed taken fresh from the plants present less difficulty than dressed seed, as the dressing is apt to damage the sterile florets. Measurements were taken from samples of seed of *P. tuberosa* from Craw's area, Kennedy's Davis-grown seed, and from seed gathered from wild *P. minor* at Palmerston North. The details for the Craw sample are: Appearance, pale to rather dark brown, shining, finely striate, with five distinct nerves; fertile florets with sparse or rather dense hairy pubescence, especially on upper two-thirds; shape, rather narrow ovate-lanceolate, gradually tapering to a point; length, about 3·25 mm., breadth about 1·25 mm.; first sterile floret, minute scale with minute appendage, up to 0·75 mm. long; second sterile floret slightly larger scale, with appendage up to 1·75 mm. long, with a few hairs or practically glabrous. The Kennedy sample is the same as the

Craw one, with perhaps a slightly greater proportion of small seeds. The details for the *P. minor* sample are: Appearance dark brownish grey, shining where not covered by hairs, veins indistinct; fertile florets with denser covering of hairs, except for distinct bald patch in lower third; shape rather broadly ovate-lanceolate, rather more abruptly narrowed to a point, length about 2·75 mm.; breadth about 1·25 mm.; first sterile floret reduced to minute scale without appendage; second sterile floret minute scale, with rather more hairy appendage, up to 1 mm. long.

Conclusions.

(1) Toowoomba Canary-grass and Harding grass are one and the same as *P. tuberosa* L.

(2) *P. stenoptera* Hack. was possibly based upon vegetative parts of *P. tuberosa* and fruits of *P. minor*.

(3) *P. minor* has at times been mistaken for *P. tuberosa*, and grown and harvested as such. It is fairly common as a naturalized plant in New Zealand, whereas *P. canariensis* is much less so.

(4) Commercial seed of *P. tuberosa* sometimes contains certain amounts of *P. minor*.

(5) It is most important both to seller and buyer that *P. tuberosa* should be provided true to name, without any significant *P. minor* content. The system of certification would ensure this.

GRADING OF CERTIFIED SEED POTATOES.

STANDARDS FOR THE CURRENT SEASON'S CROP.

J. W. Hadfield, Agronomist, Plant Research Station, Palmerston North.

The demand for certified seed potatoes is increasing very rapidly, but it is evident that the merchant and the Department of Agriculture have different conceptions as to what should constitute the main features of "certified seed."

The merchant demands varietal purity and careful grading, so that the seed may be of good appearance and readily saleable. The Department is concerned also with varietal purity, but takes into account more particularly what is termed "cropping-power," and it has left the question of grading for arrangement between the vendor and purchaser. The Department aims at the distribution of seed capable of giving satisfactory yields, and this factor is not one that can be judged from the superficial appearance of the tubers.

It is, however, evident that both points of view require consideration, and the present object is to explain the difficulties encountered in attempting to set definite grading standards, and what steps are being taken to remedy the somewhat unsatisfactory position existing at the present time.

Tags used in connection with certification have printed thereon a statement to the effect that grading is a matter left entirely between vendor and purchaser. Nevertheless, in the 1928–29 season a method was introduced by which the certifying officer could indicate on the

tag, by the use of certain figures, the grading of the seed within that sack. This method is explained later. No attempt was made to define standards for certified seed, but merely to indicate the grading of the line under inspection, so that the vendor could quote these grading figures when offering his seed; or, on the other hand, the purchaser could, in a very simple manner, stipulate a certain definite grade.

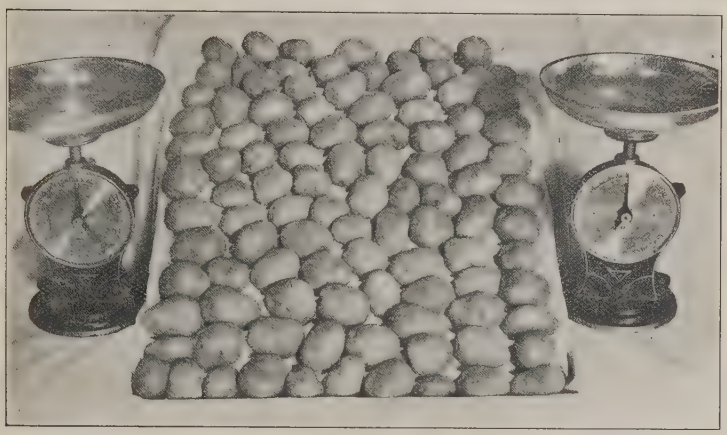

FIG. 1. EVENLY GRADED LINE OF SEED.

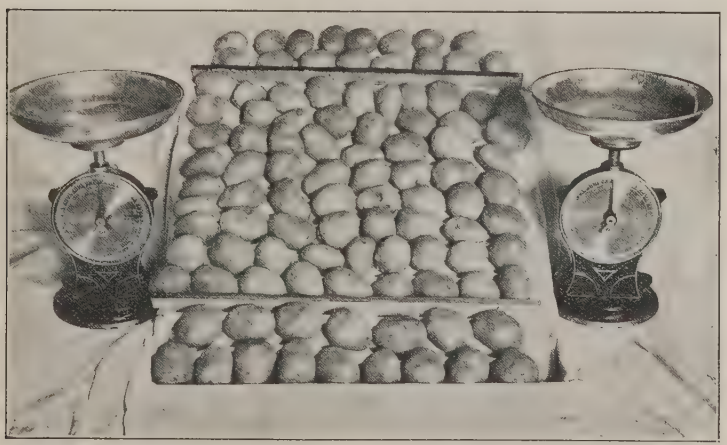

FIG. 2. SAME LINE AS IN FIG. 1, SHOWING SIXTEEN LARGEST AND SIXTEEN SMALLEST TUBERS SEPARATED READY FOR WEIGHING.

Generally speaking, growers understand the significance of these figures, but as a rule the merchants have either disregarded them or not understood their import, and an attempt is made here to explain in detail the scheme as intended it should apply to the produce of the 1929–30 season.

It seems necessary to explain, in the first place, why definite standards have not been fixed for certified seed. Such a proposal met with strong opposition from merchants in Canterbury who were handling most of the certified seed. They are called upon to fill orders from all over the Dominion, and the requirements of one merchant or one district may be very different from that of another in regard to the size of seed. Some purchasers require "table" size for cutting and planting, and, since this practice is one that the Department strongly recommends, it would be a retrograde step to refuse to certify to tubers

FIG. 3. SAME LINE AS IN FIGS. 1 AND 2, SHOWING WEIGHINGS.

The weight of the sixteen largest is 3½ lb., and that of sixteen smallest 2 lb. The grading is therefore referred to as "3½/2."

of this size. There can be no one standard to fill all requirements, and therefore it must fall to the purchaser to stipulate the grading standard, and the method here described facilitates this to a very large degree.

One requirement is probably universal—that the tubers should be reasonably uniform in size, irrespective of whether the demand is for large, medium, or small seed. A grading standard should therefore convey in simple terms (1) the average size of the tubers, and (2) the range in size—that is, uniformity of grading. The average weight of tubers may be 3 oz. in a line ranging from 1 oz. to 8 oz., but will not be as well graded as a line having the same average weight but ranging in size from 2 oz. to 4 oz.

The use of sieves to determine size is unreliable, giving varying results according to the way they are used and the tuber-shape of the variety. Moreover, growers would have to purchase a whole range of

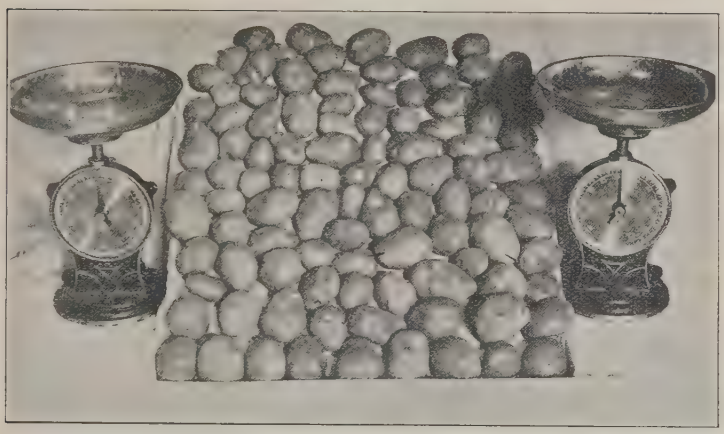

FIG. 4. BADLY GRADED LINE OF SEED.

sieves. On the other hand, probably every home has a set of moderately reliable scales, and taking tuber-weights is both accurate and convenient, and falls into line with the custom of referring to the size of tubers in terms of ounces.

It has already been explained that the average weight gives no indication of the uniformity of grading, but the degree of uniformity

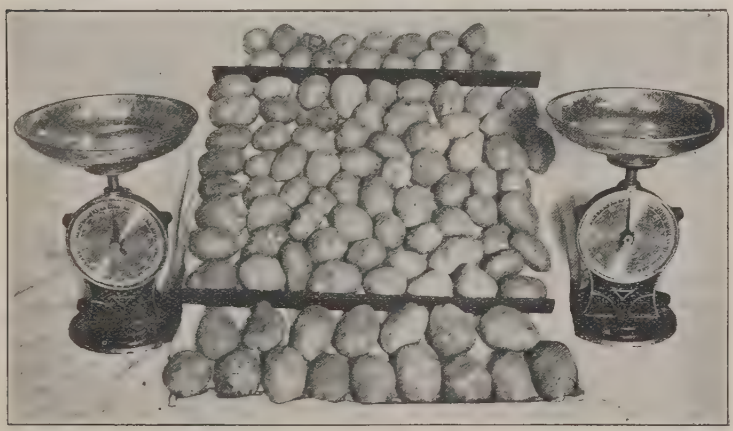

FIG. 5. SAME LINE AS IN FIG. 4, SHOWING SIXTEEN LARGEST AND SIXTEEN SMALLEST TUBERS SEPARATED READY FOR WEIGHING.

may be indicated by taking at random a definite number of tubers from each sack till 100 are obtained (see Figs. 1, 2, and 3). If these are laid out on the ground they represent to the eye the average grading of the sacks sampled. To convey this grading in terms of figures the method adopted is to separate by eye measurement the sixteen largest and the sixteen smallest tubers. If these lots are weighed separately the weight will convey, after some little practice, a reasonably accurate idea of the standard of grading in that particular line. Sixteen tubers afford a convenient number, because if the weights are recorded in pounds they indicate also the average weight per tuber in ounces. Thus a line grading "6/3" means that the sixteen largest tubers weigh 6 lb. as against 3 lb. for the sixteen smallest. It also indicates that the

FIG. 6. SAME LINE AS IN FIGS. 4 AND 5, SHOWING WEIGHINGS.

The weight of the sixteen largest is 4¾ lb., and that of the sixteen smallest 1¾ lb. The grading is therefore "4¾/1¾." There being more than 2½ lb. between the two weights, the line would be rejected for inefficient grading.

average weight of the sixteen largest tubers is 6 oz., and the average of the sixteen smallest 3 oz. The range is from round about 6 oz. to round about 3 oz. A few tubers will be over 6 oz. and a few below 3 oz. These grading figures are always to be found on the tags attached to the sacks by the grower. If the merchant regrades, the figures, of course, fail to be of any value.

The final tuber-inspection for certification is undertaken when the seed is graded, in sacks, ready for sale. At least one sack in every six is opened up (with a minimum of eight sacks in any one line) and twenty-five tubers are taken at random from every sack opened. Each lot of 100 tubers is weighed for the grading standard. Each tuber is inspected, and a certain proportion cut to determine the percentage of disease present.

GRADING STANDARDS FOR THE 1929–30 CROP.

In regard to grading, the following standards will be adopted for the 1929–30 seed-crop :—

(1) If the sixteen largest tubers weigh under 2 lb. the line should be rejected.

(2) If the sixteen smallest tubers weigh under 1¾ lb. the line should be rejected, but may be regraded and again inspected at the convenience of the certifying officer (Fig. 7).

(3) If the sixteen smallest tubers weigh more than 4½ lb. the grading figures should be indicated on the tag and the tag branded "Table" (Fig. 8).

(4) If the difference between the weight of the sixteen smallest tubers and the weight of the sixteen largest tubers exceeds 2½ lb. the line should be rejected for inefficient grading, but may be regraded and inspected at the convenience of the certifying officer (Figs. 4, 5, and 6).

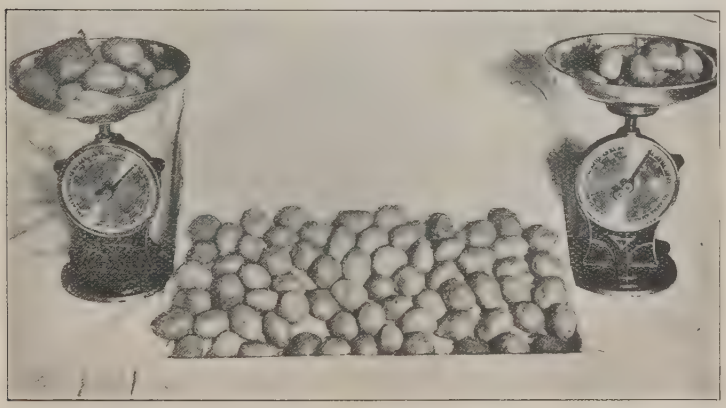

FIG. 7. LINE OF SEED WHICH GRADES "1¾/1¼."

The weight of the sixteen largest being below 2 lb., and that of the sixteen smallest below 1¾ lb., the line would be rejected on both counts. Grade 2/1¾ is the smallest size which will be accepted and tagged.

PURITY AND DISEASE STANDARD.— FINAL TUBER INSPECTION.

In this connection the certifying officer will reject if there are present more than 2 per cent. of rogues (foreign varieties), 3 per cent. of late blight, 4 per cent. of powdery scab, 2 per cent. of bacterial rot, 4 per cent. of potato moth, 4 per cent. of eel-worm, or 7 per cent. of dry-rot, badly scabbed, or badly damaged tubers.

These standards are not permanent. They represent a tightening of the previous season's regulations, and it is probable that the following season will see the percentages of rogues and disease allowed in certified seed still further restricted.

ACCEPTANCE OF CROPS PLANTED WITH CERTIFIED SEED NOT A MATTER OF COURSE.

It is obvious that a farmer who plants certified seed will not necessarily have his crop accepted; in fact, it may be very much below the standard of the seed he purchased. Northern Star is the most common rogue in our white varieties, and increases so rapidly that 2 per cent. present in a certified line has been known to increase to 7 per cent. in one season. If the standard of purity were 100 per cent. the position would be different, but as matters stand at present growers must at all times be prepared to rogue their crops. The presence in a crop of such factors as late blight, potato-moth, dry-rot, scab, &c.,

FIG. 8. LINE WHICH GRADES "7/4¾."

The sixteen smallest tubers being over 4½ lb., the tag would be branded with the word "table."

depends not so much upon the seed planted as upon climatic, soil, and management factors. It would be unwise to distribute seed containing an undue proportion of tubers affected with late blight, but whether the subsequent crop is affected depends almost entirely upon the climatic conditions during the growing-period. It is obvious, therefore, that the planting of certified seed carries no guarantee that the resultant crop will be passed. The use of certified seed is a wise and reasonable precaution which will ensure that under normal conditions satisfactory yields will be obtained, provided the variety is suited to the locality.

Certificate-of-record and Official Herd-test.—During March, 1930, 846 cows, in the ownership of 267 breeders, were under C.O.R. test, as compared with 649 cows and 226 breeders in the corresponding month of 1929. The O.H.T. figures for March, 1930, were 1,341 cows and 128 breeders, as against 1,569 and 122 respectively for the same month last year.

COLD STORAGE OF APPLES.

INVESTIGATIONS AT NELSON, SEASONS 1927 AND 1928.

An account of the main investigations of the Cawthron Institute into some of the difficulties associated with the cold storage of apples in the Nelson district during the 1927 and 1928 storage seasons is given in the recently published Bulletin No. 16 of the Department of Scientific and Industrial Research, by Mr. L. W. Tiller, Orchard Chemist to the Institute. The report is summarized as follows :—

(1) For securing uniformity of temperature at all points in a small experimental chamber cooled by a direct expansion dry battery situated outside the room, an air-circulation system operating from ceiling to floor has given the best results.

(2) Less internal breakdown develops in a store in which the relative humidity of the air is kept low than in a store where the humidity is high, provided the flesh-temperature is the same in both stores.

(3) Internal breakdown is more in evidence at low storage temperatures than at high, although varieties differ considerably in their power of resistance to low temperature.

(4) Internal breakdown as it occurs in the Nelson District is compared with similar physiological diseases occurring in America.

(5) Fruit grown on good soils generally shows superior storage qualities to that grown on naturally poor soils.

(6) Cultivation of the orchard and climatic factors exercise a profound influence on the keeping quality of the fruit.

(7) A well-balanced manurial programme carried out on the orchard has materially improved the storage qualities of the fruit.

(8) The root-stock upon which a variety is worked may influence the condition in which the variety turns out at the end of its storage period.

(9) Jonathan-spot is differentiated from bitter-rot, with which it is frequently confused.

(10) A limited measure of control of Jonathan-spot is afforded by the use of oiled wrapping-paper.

(11) Soil conditions and manurial treatment of the orchard cannot at present be correlated with the incidence of Jonathan-spot.

(12) Except in one instance, temperature has had no consistent effect on Jonathan-spot development. In the exceptional case there was less trouble in evidence at a storage temperature of about 38° F. than there was at 32° F.

(13) Storage humidity has had no effect on the incidence of Jonathan-spot.

(14) Delay between picking and storing usually causes a slight rise in the percentage of Jonathan-spot, but the increase is very small compared with that produced by late picking.

(15) The best control of Jonathan-spot at present available is given by picking the fruit as early as can be done without sacrificing the essentials of colour and flavour.

(16) The use of oiled wrapping-paper gives a very substantial reduction in the amount of shrivel in stored apples without detrimentally affecting them in other ways.

(17) Jonathans picked and packed as for export were put into store for three months and then kept out of store for periods up to three weeks. In no line did severe breakdown exceed 3 per cent., and fungal trouble was almost totally absent. Factors governing this experiment are similar in some respects to those obtaining in the New Zealand export trade.

SEASONAL NOTES.

THE FARM.

The Pastures.

DESPITE the fact that harrowing of pastures has greatly grown in popularity there remain many farmers who do not harrow as much as could profitably be done. Autumn harrowing of pastures proves of particular value. This can be understood when it is remembered that one of its objects is the proper distribution of animal-droppings which, if left long undistured, tend to make the pastures uneven and of coarse rank undesirable growth in patches, whereas if the droppings are properly distributed they exert a considerable valuable manurial effect. This probably is recognized only in the older countries, in which the utilization of animal-manure receives so much attention. It can be grasped from the fact that careful investigation has indicated that in a year the dung produced by a herd of forty cows contains fertilizing-matter equivalent to 12 tons sulphate of ammonia, 6 tons sulphate of potash, and 3 tons superphosphate.

The current cash value of this manurial material is well over £200. Efficient harrowing in the autumn results in much of this fertilizing-material being placed in the best position to serve well as nutriment for the grass crop, whereas without harrowing the material would increase the difficulty of proper pasture-utilization and also tend to bring about pasture-deterioration.

The importance of the proper utilization of animal-manure requires to be kept in mind not because animal-manure may take the place being given to artificial fertilizers, but because a knowledge of the fertilizing-value of animal-manure makes clear one of the purposes and values of grassland harrowing. Reference to the great cultivation value of harrowing was made in last month's notes.

The autumn top-dressing of pastures was also dealt with in some detail last month. If dependence is to be placed on a single annual top-dressing it is highly probable that the best financial returns will be secured by applying it in the autumn. Especially should autumn top-dressing be practised if there seems any likelihood of a shortage of feed during winter and early spring. Once adequate rains have fallen such top-dressing will induce extra late autumn and early winter grass-growth.

In the autumn young pastures require careful treatment; therefore they should not be grazed too closely, neither should they be allowed to become long and productive of seed. At times it may be of assistance in bringing about strong vigorous establishment if 1 cwt. of sulphate of ammonia to the acre is applied in the autumn to young pastures, once the soil is supplied with adequate moisture to make this manure effective. If the young pastures have not recently been dressed with phosphates, then the sulphate of ammonia would be only an addition to the dressing of phosphates which usually would be required, and which generally would be of greater primary importance than the nitrogenous dressing. Sulphate of ammonia may be mixed with superphosphate, but not with basic slag or any other substance containing lime in any form.

At the time of writing dry conditions are general, and farmers may be delaying the work of top-dressing. Even if rain does not fall it is advisable to top-dress with phosphates so as to be able to secure immediate extra fresh growth as soon as the requisite soil-moisture has been supplied.

and so as not to have too much top-dressing work on hand late in the season. There is no danger of the benefits of phosphates being lost when applied under dry conditions; they will act as soon as these conditions cease. With nitrogenous manures, such as sulphate of ammonia, it is different, and farmers who are contemplating its autumn application would be well advised to delay distributing it until rains have been experienced.

Cereal-growing.

Important autumn work in connection with cereal-growing was discussed in the March *Journal* notes. Matters particularly calling for attention are the control of disease and the use of manure. For the control of disease it will be found profitable to treat the seed in the ways recommended by the Plant Research Station rather than in the manner sometimes adopted. The results of extensive field experimental work show that it is generally sound practice to apply at least 1 cwt. of superphosphate with autumn-sown cereals. Hence it is a matter for congratulation that last year in Canterbury 3 acres out of every 4 acres of wheat grown received on the average a dressing of slightly more than 1 cwt. of manure to the acre.

Autumn Utilization of Crops.

The fact that dairy cows are "drying off" is neither a sound nor a wise reason for subjecting them to poor feeding. The rule is that successful dairy-farmers feed the cows well during the non-production period. By doing this the cow's body and constitution are built up, thereby enabling the cow to stand the strain and the drain of several months' heavy production.

This building-up process carried out while the cow is not producing is desirable particularly with cows of heavy yield, because it is likely that such cows will utilize for production during the early part of the milking-season more nutriment than they consume; hence it is necessary that they be able to draw upon their body reserves. The cow that is well fed during her non-producing period can be expected not only to yield better after calving if she remains healthy, but also to be able more effectively to resist attacks of disease germs, and therefore more likely to remain healthy. Wide observation has established the fact that there is nothing in the belief that it is undesirable to have the cows in good condition at calving-time; and indeed that the truth lies in the contrary idea that they should be in a position to work off some of their body-weight during the early part of the season without becoming unduly lean. All this leads to the conclusion that forage reserves should be sufficient to allow of an early commencement of feeding of such materials as hay, roots, and ensilage, in case pasture-growth is inadequate to maintain the stock in good condition prior to the advent of winter conditions.

The first winter is a trying and critical time with young farm stock, hence calves and hoggets should receive the best possible attention, especially in respect to feeding. With this in mind, calves should be induced to commence the eating of hay, ensilage, or other fodder strange to them before they really require it. By doing this a possible set-back at a critical stage will be obviated, in that it will be unnecessary for them to undergo a sudden more or less complete change in diet—and that at a stage when they have become somewhat poor in condition. Further, they should be supplied as long as possible with clean, short, fresh pasture.

Likewise, if it is at all possible, hoggets should be turned on to fodder crops before they have become low in condition. This should be done gradually, allowing them a run on suitable pasture, so that their digestive organs will not suddenly be called upon to function on a completely changed diet.

In the feeding of hay, ensilage, and roots, the following points are worth keeping in mind: (1) If done on the poorer parts of a field the feeding of such fodder will ordinarily tend to improve the soil of those parts; (2) if at all possible feeding out should not be done under wet conditions, as this will result in poaching of the ground; (3) hay saved at an overmature stage may contain seeds of valuable pasture-species, which if scattered and trampled in may germinate, establish themselves, and produce highly beneficial thickening of an open weak sward.

When turnips are to occupy an important place in the winter feeding of hoggets, the hoggets should be the first stock put on to each break of turnips, to be followed, after the tops have been eaten, by any sheep that are being fattened, and then by the breeding-ewes when the turnips have been grubbed to make it easier for the sheep to eat the portions which remain.

Farm Subdivision.

Efficient utilization of the farm-pastures is dependent to some extent upon the number and arrangement of the internal fences. During the next few weeks there should often be convenient times in which to make any fencing alterations or additions which will tend to give better grazing-management. Such work deserves very careful forethought. One important aspect—that of the water-supply for stock—may advantageously be given immediate consideration on many farms; the prolonged spell of dry weather experienced generally this autumn will have resulted in the stopping of the flow from all but the most reliable sources of water. Those places from which a supply of good water is still obtainable should be carefully noted, so that they can be taken into consideration when any subdivisional work is being done.

—R. P. Connell, M.A., Fields Division, Palmerston North.

The Clipping of Horses.

It is now seasonal to consider the question of clipping horses, and the object and advantages to be obtained by carrying out this practice. Nature has provided an extra-heavy coat for the colder months of the year in the case of animals which live under natural conditions. Rabbits' pelts give a good example of such a provision. The domestic poultry moult, and a new growth of feathers is provided before the winter months. Horses and cattle wintered out-of-doors retain the old season's coat right through the winter as a protection against climatic conditions, even though the new coat is growing underneath. It is only in the spring and early summer that normally this coat is lost.

In the case of domestic animals being utilized for man's convenience the question of removing the old coat by clipping is one of seasonal and district importance. The horse is man's beast of burden, and to obtain the best results in work the farmer must use all care in the feeding and general welfare of the animal. In spite of the advent of motor-power on the farm, horse teams are still much in evidence, especially in the South Island, and the working-life of the team and the results obtained will be increased considerably by the care bestowed in the management of the animals. In the North Island, where teams are not often used to the same extent, and where horses are required for more spasmodic work, the question of clipping does not merit the same consideration. An animal only required for hacking purposes or doing a trip to the dairy-factory once or twice a day is not greatly inconvenienced by an excessive coat, especially as in between times it is not housed but allowed to graze.

To obtain the best results from a working team which is having constant employment, clipping and daily grooming are most important, in addition

to a generous diet. Grooming, by providing a daily stimulation of the skin and a healthy coat, cannot be effectively carried out with heavy horses unless the winter coat is removed. It has been noticed repeatedly that horses improve in condition as a result of clipping and thorough daily grooming. If the coat is not clipped horses in heavy draught work sweat profusely at this season of the year, and this is often followed by a troublesome cough. The hair becomes matted with the sweat, dust, and scales from the skin. Such a condition readily leads to shoulder or saddle galls, either of which may upset the working ability of the team. In the case of racehorses getting fast work, the animals are sponged down immediately and the saddle removed, and it is well known that the amount of time spent on grooming these animals is not limited; the coat is never allowed to become excessively long unless the animals are being spelled.

The question arises as to what area of the body should be clipped. Each farmer requires to consider whether his team can be kept fairly constantly employed. If it can be so employed it is advisable to clip the body but leave the limbs. The long feather on the limbs is a protective covering, and from a health point of view it is not advisable to interfere with this. In cases where horses are not doing much carting the shoulders may be clipped, the line tapering back to the flank, or what is commonly spoken of as "trace-high." The shoulders should always be clipped as a preventive of shoulder-galls.

There are many points in favour of clipping, and very little can be said against the practice. Clipped animals are capable of more sustained work, and grooming with all its beneficial results can be more effectively carried out. Horses running outside in winter are usually protected by a waterproof rug, which is sufficient covering against rain or wind if the legs are not interfered with. An extra warm lining may be inserted under the waterproof in the region of the kidneys. If horses are clipped before the cold nights and frosts become prevalent no bad after effects should be experienced. It may be said in conclusion that, next to feeding, clipping and grooming are the two most essential requirements in good horse-management.

—J. E. McIlwaine, M.R.C.V.S., Live-stock Division.

THE ORCHARD.

System in Picking.

PICKING and packing for storage or export will still be the main activity in orchards during the coming month. The overlapping of ripening in some of the main late varieties calls for constant vigilance, so as to arrange the sequence of picking that an even degree of maturity is maintained throughout the crop. The possibility of bad weather delaying operations must be borne in mind, for the injury to trees which have been lightly picked over is likely to be less severe than in the case of fully laden ones. The grower's anxiety decreases coincidently with the reduction of the weight on the trees, and it is then possible to regard with complacency a fairly heavy gale, knowing that the unavoidable losses will be reduced to a minimum. By commencing to pick as soon as there is a sufficient quantity of fruit with the requisite degree of maturity, and making periodical pickings as the remainder develops, the undersized and backward fruit is given an opportunity previously denied it, when it will often produce the finest-flavoured fruit in the crop. For this reason many growers leave a portion of the last picking of Sturmers on the trees to fully mature for their household requirements.

Securing Injured Trees.

Any split trunks or limbs should be braced into position and securely fastened without delay. If left until the winter the bark will have hardened in the contracted position, and interference will cause further injury. With large limbs it may be advantageous to use a wire strainer to draw the portions into close contact before securing with a bolt or wire brace, or both. Close contact is essential to the future welfare of the tree, for exposed injured surfaces to which rain and air have access are liable to internal decay, which may ultimately destroy the tree. After the injured member has been firmly secured in position the wound should be painted with tar or grafting-wax, and any crevices plugged to aid in the formation of new bark and to reduce the hibernating-places of codlin-moth and other insects. For bracing limbs heavy plain fencing-wire will be found the most satisfactory. A hole of the same diameter as the wire is bored through the limb to be braced and the one to take the strain; the wire is threaded through, and the ends bent downwards at right angles to hold the limb, obviating the danger of ring-barking, which may occur if the wire is bent round the limb.

Peach-stones should be sown immediately to provide stocks for next summer's budding. The stones should be sown thickly, and covered lightly with soil. Early next spring they will start into growth, and when about 2 in. or 3 in. high, or large enough to handle, they should be dibbled into nursery rows, and will be ready for budding the following February or March. Any budding this season should be completed as early as possible. The sap-flow will be decreasing with the cooler weather, and the bark will not lift readily enough to ensure success if the operation is delayed too long.

Miscellaneous Work.

Orchard props should be collected as soon as they can be dispensed with. Each season often seems to find the previous season's props a diminished quantity, entailing further expense in replacements, which could in part be avoided by early collecting and storing in a dry place.

The planting of shelter-belts can be proceeded with as soon as there is sufficient moisture in the ground. A thorough preparation of the site and periodic hoeing until the trees are well established will hasten the production of satisfactory shelter. The kind of tree planted must be governed by requirements and the physical features of the site, but consideration must be given to the probable spread of the limbs and roots, and the detrimental effect on adjacent trees.

The time may be opportune for a clean-up in stone-fruit of fungi such as brown-rot, rust, leaf-curl, &c., by the use of bordeaux, 6–4–40. This in conjunction with ploughing and the destruction of mummified fruit will reduce the source of infection for next season's crop. If scale has been troublesome it will be advisable to use lime-sulphur, 1–15, before leaf-fall.

Citrus-culture.

Preparation of the land for winter should be pushed on as circumstances permit. Owing to the surface-rooting habit of citrus-trees it is not advisable to plough deeply until there is sufficient moisture in the surface soil to preclude the possibility of the trees receiving a set-back.

Land for planting should be ploughed and subsoiled as early as possible, and reduced to planting-condition in frost-free localities where planting can be done in the autumn. Anything approaching a waterlogged condition is fatal to successful citrus-growing, and where natural drainage is lacking ample provision must be made for the rapid removal of surplus water by artificial drainage. The sites for the rows will need special attention, filling any depressions, a slightly ridged condition being preferable

to a uniformly flat surface. If spring planting is intended the rows should be left as rough and open as possible for sweetening, and the intervening spaces sown in cover-crop for feeding off or ploughing in. A dressing of lime should follow the ploughing.

The present is a good time to do any light pruning. The crop will be sufficiently advanced for the unproductive, worn-out wood to be located, and this, together with any crowded growths or soft water-shoots, should be removed, with the object of so shaping the tree that the inside fruit can develop normally and picking be done with the minimum of discomfort. In anticipation of wet weather and brown-rot attack the lower foliage should be trimmed to a height of about 18 in. from the ground, followed by a 4–4–40 bordeaux spray. Manuring at this period with nitrogenous fertilizers is inadvisable, owing to the liability of stimulating soft growth which would be highly susceptible to frost injury.

Picking should be done regularly and often. Tree-ripened fruit has the lowest commercial value, poor keeping qualities, and from the retailer's and consumer's viewpoints is generally unsatisfactory. The popular demand is for cured fruit which can be relied upon for its keeping-qualities, and the marketing of fresh-picked fruit is undoubtedly the principal factor governing the sustained demand for imported lemons. "Tree-ripes" and "oversizes" in a well-regulated orchard may be regarded as an accidental product fit only for factory use. Picking at intervals of two or three weeks as the fruit attains the desired size, and storing it until sufficiently coloured, eliminates the bulk of the culls and provides the desired article.

—G. H. McIndoe, Orchard Instructor, Gisborne.

POULTRY-KEEPING.

Seasonal Management.

If poultry-keeping is to be made a successful undertaking it is of the first importance that a sound system of management be resorted to at all periods throughout the year. In other words, doing the right thing at the right time is the keynote to success. The month of May is usually regarded as the leanest period in the poultry-keeper's year, but for the man who has worked on sound lines by the culling out of all unprofitable stock, and who has only the best of the hens which have terminated their first laying-season, no surplus male birds, and a flock of pullets bred and managed to lay in winter, the forthcoming month should show a good return over cost of production. On the other hand, for the poultryman who has neglected to cull his inferior hens and pullets, or if his pullets through being improperly cared for have gone into a false moult, failing to produce, next month will probably show a loss instead of a gain.

Although May can generally be regarded as a slack period of the year, there are several matters, apart from the ordinary routine work, which require attention if the plant is to be maintained at a high standard of efficiency. In the first place, special attention should be directed to the feeding of the prospective breeding-hens. They should be well fed but not overfed. Every effort should be made to prevent the birds becoming in an overfat condition during the moulting-period or just before being called upon to produce eggs for reproduction purposes, as eggs containing strong germs, and chickens that are easy to rear, cannot be produced from an overfat hen. The birds should be frequently handled, and if there is a tendency for them to put on surplus fat the ration should be slightly reduced. They should also be encouraged to exercise as much as possible as a means

of preventing the storing-up of bodily fat. In the case of a laying flock I believe in feeding the birds well from first to last, but it is wise at times to depart from this rule where the breeding-hen is concerned.

The prospective breeding-cockerels also require special food and attention in order that they may be in the best possible nick at mating-time. The young birds should be prevented at all costs from going weak in the legs. This trouble is usually the result of an oversupply of forcing-food or a lack of exercising-space. It should be remembered that once a bird becomes badly affected with this trouble it is next to useless trying to doctor it. Prevention is the one and only safe course in dealing with this trouble; the only reliable method is to eliminate rich food such as meat, milk, &c., from the ration, and to allow ample opportunity for exercise. The ideal condition for the breeding-cockerel is a free range, as in this way a bird is given every opportunity of building up constitutional vigour, which is essential if desirable progeny are to be produced.

Secure Stud Male Birds early.

A common mistake made by many poultry-keepers who contemplate purchasing stud male birds is to leave the securing of these till too late, thereby running the risk of having to be content with the culls of the stud breeder. The most successful breeders naturally retain the best of their cockerels for their own use, the first buyer secures the pick of the remainder, and so this process goes on until the last-comers have to take those that have been practically discarded. The wise poultry-keeper buys his sires well ahead, and is thus in a position to feed and manage them in such a manner that they will be in the best possible condition at mating-time. The sire is more than half the flock, and if he is to have the desired prepotency—the power to transmit his inherent quality to his offspring—he must be in the best condition possible, not overfat but full of life and vigour.

If a stud breeder has to keep cockerels for a year, or nearly so, he cannot sell these at a moderate rate and show any decent margin of profit. The cockerels have to be fed and attended to for the whole of that period, as well as taking up housing and runs at the same time. Further, how many cockerels come through a year and develop into birds which would do credit to a plant? A large proportion have to be potted by reason of natural defects developed with age, or by accidents, which will always occur, especially with pugnacious birds, as once a flock of vigorous cockerels commence fighting there is no telling what damage they will do to each other from a breeding standpoint. In short, the birds which finish their first year's existence and are fit to send out represent only a small proportion of the cockerels raised. These birds when sold should return sufficient money to more than cover the whole cost of rearing the cockerels reserved for sale. Another drawback to the policy of waiting till the last moment to purchase a stud cockerel is that it is next to impossible to buy anything at all good in the spring.

This brings to mind an inquiry recently received from a person who desired to purchase two White Leghorn cockerels from the Department's Wallaceville Poultry Station. He intimated that he would pay the price as stated in the official price-list, but did not want to take delivery of the birds until the end of August. This was asking too much, particularly in view of the moderate prices charged for the high-class stock sent out from Wallaceville.

At the present time there are a good number of well-matured high-class cockerels and White Indian Runner drakes at Wallaceville available for disposal at moderate prices, but unless orders are received for these in the near future they will be potted, as it is obviously unprofitable to

keep them longer even if all could be sold later on. In the advertising section of this issue will be found the conditions and prices at which birds for breeding purposes may be secured from Wallaceville.

Standard Grade Eggs.

The question of selling eggs according to their weight and internal quality is receiving more attention than ever before in many parts of the world, including England and Canada, and New Zealand is at last awakening to the necessity for this move. Should this much-needed reform be carried into effect it is safe to assume that nothing less than a 2 oz. product will be regarded as first-standard grade. Under the present system of marketing—at any rate so far as Wellington is concerned—the man with a small-egg strain of birds is in a happy position, as he receives a similar price for his 1¾ oz. eggs as the man with a 2-oz.-producing strain. Obviously the consumer pays on this basis relatively too much for small eggs and not enough for large ones.

The worst feature of this system lies in the fact that there is no inducement for the producer to breed for large eggs. I have in mind a flock of Black Minorcas which, apart from the early-laying stage of the pullets, can generally be depended upon to produce eggs weighing from 2 oz. to 2¼ oz. While the great merit of many strains of the domestic fowl we possess is undeniable, there is a tendency for the average flock to become smaller and smaller individually each year; consequently the eggs laid are also smaller. Although the present system of marketing gives little or no encouragement to breeders to work up a large-egg strain, it is satisfactory to know that there are still in the Dominion strains which retain the needed size, stamina, and power to produce good numbers of first-grade eggs. The warning, however, is at hand that the consuming public will not long continue to pay top prices for eggs which rattle in the egg-cup.

Poultry-keepers possessing a small-egg strain would be well advised to mend their methods of breeding and management, so that at least the great majority of the flock will produce 2 oz. eggs or over—the size so much desired not only on the local market but overseas as well. Just as the number of eggs can be increased by careful breeding and selection, so can the size be increased by the same process. The tendency to small eggs will never be counteracted while yield in numbers is regarded as the one and only essential in a breeding-bird. A hen, however good a layer, should not be put in a breeding-pen if it lays a small egg. The birds laying the best eggs should be chosen provided, of course, that their laying-capacity is satisfactory, and that they possess points indicating a strong constitution.

As a means of tracing birds which lay good-sized eggs the use of trap-nests or single pens is necessary. It is true that the man with a trained eye for form can generally distinguish between the good and bad layer towards the end of their first productive season, but it is impossible to judge from the appearance of a bird at any period of its life the size of egg likely to be produced. It must be admitted that individual hens will sometimes lay eggs of varied size according to the season of the year, &c., but as a rule a normal product may be looked for a few weeks before the termination of the first laying-season. One of the secrets in maintaining a large-egg-laying strain lies in knowing that the male bird is the son of a mother that produces an egg of a desired size. Obviously this cannot well be ascertained unless the use of trap-nests or single pens is resorted to.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Uniting Colonies.

THE presence of weak hives in the apiary must be avoided as far as possible. During the warm autumn days these colonies rarely escape the attention of robber bees, and are easily molested. When once they are attacked the beekeeper will find it extremely difficult to save them, and eventually they will get robbed out despite his efforts. It is far the better plan to unite the bees with a stronger colony than to run the risk of unsettling them in the dormant season through the encouragement of wholesale robbing.

Efficient Hive-covers.

With the approach of the rainy season it is advisable to make a complete examination of the hive-covers in use. Altogether too little attention is paid to making the covers watertight, and neglect in this direction leads to winter losses. No amount of labour should be spared in saving the bees from exposure and dampness, by so doing warding off the large annual losses that occur through neglect. There is no excuse for the beekeeper neglecting to protect his bees, and he will find in the long-run that a small expenditure on some suitable waterproof roofing-material will doubly repay him, and will be the means of saving colonies that would otherwise be lost. Bees must be kept dry. An examination made of colonies where proper protection is not provided will reveal the presence of large quantities of propolis. Usually this is collected to prevent the penetration of external moisture, and it is noticeable that it is gathered freely in the autumn months. Where adequate protection is provided the bees are to a large extent saved the labour of collecting the propolis, and by providing dry roofs the beekeeper is assisting them.

In the case of roofs that are cracked no attempt should be made to tinker with them, but covering entirely done with some waterproof material. In the long-run metal coverings are the cheapest and the best. Good zinc or galvanized iron makes ideal covering, and will last for many years. However, quite a number of beekeepers are now using "ruberoid" or similar materials with very good results. While not so durable as metal, they serve the purpose admirably, and with careful treatment will last for a number of seasons.

Handling of Spare Supers.

Where extracted combs have been placed on the hives for the bees to clean up, these should now be removed and the bees confined to as small a space as possible consistent with the size of the colony. It may be necessary to leave some of the supers on during the winter months, and these can be dealt with in the spring. Do not leave the bees more space than they require, as it will be found that they will desert the lower supers and cluster at the top for warmth.

Provision of Hive Mats.

It should be seen that each colony is provided with one or two good mats during the winter months, so as to keep the bees as warm as possible. Mats should be cut to fit exactly on top of the frames, and may be made from clean sacking or canvas. Sugar-bags or corn-sacks make excellent mats, and are easily procured. Wood mats are adopted by some beekeepers, and, if desired, may be secured at a moderate cost from dealers in bee material. In districts where the bees do not bring in a great deal of propolis wood mats are effectual. On no account use calico mats, as these afford practically no warmth.

Winter Setting of Hives.

The hives should be kept clear of all weeds, so that the flying bees may have free access to the entrances. Many bees are lost by striking growing obstacles on returning to the hives. For the next few months, when the air is more or less charged with moisture, it is important that plenty of air and as much sunlight as possible should penetrate beneath the bottom-boards. In damp situations place the hives sufficiently high from the ground to avoid the dampness. Old bricks or concrete blocks make admirable supports for the bottom-boards. Make sure that the hives have sufficient cant towards the front before the winter rains set in. The presence of much moisture on the bottom-boards will be the means of much loss to the beekeeper, and, in addition, cause the hives to become sour and foul-smelling.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Small-fruit Culture.

THE month of May is the commencement of the short planting-season, when hard-wooded plants may be safely removed, and of the three to four months when this may be done it is the best. There are great advantages in having plans completed and land prepared ready to commence planting with the opening of the planting-season. Root-growth is very active during the winter, and plants set out now are well prepared, when spring arrives, to make the best possible growth during the first season.

Take delivery of your orders as soon as the plants are ready for lifting, and, if it is inconvenient to plant at once, or if the ground and weather are too moist, heel the plants in thinly in a spare piece of friable soil, and they will be quite safe there until planting may be started. Before doing this, examine the plants carefully to see they are sound and vigorous, discarding any that are not true to type or up to grade. The first loss is the least, and much better is it to discard poor plants now than to give them land and attention when experience has definitely proved that such are unprofitable. Attention to this one point alone will improve most plantings by 25 per cent., not that the biggest plants are always the best, especially when the root-growth is poor. A good root-system is of first importance, and next to that it should be seen that the tops are fairly well furnished with well-ripened growth of moderate length.

If such plants are set out now when the soil is friable and free from the least tendency to be sticky, a good start is obtained, and "the start is all." Plant slightly deep, and carefully firm the ground well about the roots with the heel of the boot.

Most plants of this class thrive best in a moist soil, but the least tendency to *stagnant* moisture is detrimental. If there is any tendency for flood-water to lie for a time on the surface, or anywhere within reach of the rooting-area at any level, a drainage system must be arranged to run the water off.

The Market-garden.

Where grassland is to be broken in for this class of cropping it is necessary to start early and give the soil time to mature. Under ordinary conditions the hedges should be trimmed well back, and the land skim ploughed now. When the turf is dead, cross plough the land deeply, turning the turf well under. At the same time the land may be subsoiled, or that operation may be deferred for another season. Let the land then

lie rough until near planting-time, when it should be broken down sufficiently fine for the purpose. Where planting is not done until the middle or late spring the land should be harrowed and cultivated to destroy seedling weeds as often as may be necessary. As a few bad weeds are still probably present at this stage it is usually advisable for the first season to plant crops, such as peas and potatoes, that will resist their encroachment, as well as permit thorough cultivation and cleaning of the ground.

If these paddocks are of 2 to 5 acres in extent, with good hedges, rather high, one has ideal conditions for cropping. If sufficient shelter is not established it should be completed with the greatest consideration and care. It may not be a marketable crop in the ordinary way, but it is a farm improvement of the most valuable kind, and probably costing least in cash expenditure. Its value will chiefly lie in its being well selected, placed, and trained. This will cost some thought, which is something with which one is inclined to be parsimonious. On good land of this class *Cupressus Lawsoniana*, planted 2 ft. to 3 ft. apart, makes a good evergreen shelter-belt on the side of the prevailing wind, or *Cupressus torulosa* or *sempervirens* may be used. Of the latter, seedlings with rather a spreading habit should be chosen. These cypresses will grow naturally to a height of 15 ft. to 20 ft., and be well furnished with breast wood of moderate length, thus requiring little trimming and no topping.

Secondary shelter-belts are best formed with barberry, holly, or privet, planted alternatively with Lombardy poplar. This provides excellent shelter with little labour. On the lee and sunny side the ordinary hedge is usually sufficient. The amount of shelter of this kind that may be required will depend upon locality, but more usually it is deficient. It is only excessive where plantations of large pine-trees and gums rob and shade the land, or where in a humid climate the few crops which like an open situation are closely enclosed.

New shelter-belts and hedges of this kind require clean cultivation for a few years—that is, until they are well established. Of those mentioned above only the barberry, holly, and privet will require cutting down annually to thicken the base of the plants. The others will furnish naturally in a suitable manner; moderate side-trimming alone may be required. Here again, plant no culls, but well-furnished plants of even size.

A sowing of early peas and planting of cabbage and cauliflowers for spring cutting are often started now. Warm, well-drained land should be chosen for these crops.

The Home Garden.

Lawns sown early in March will now have had their first mowing, and with their verges trimmed will have quite a smart appearance. If the shrubbery borders have been trenched or subsoiled, manured, and cleaned they will now be ready for planting. In making a selection for the purpose the first consideration is the main features of the garden, composed generally of perennial shrubs of special interest, such as rhododendrons, heaths, roses, or native flowering-plants. Between the species and different hybrids of any of the kinds mentioned there is ample material from which one could plant half a dozen gardens that would be quite distinct.

The next consideration is a suitable setting of shade and shelter trees. These may be numerous and large, or few and of naturally moderate dimensions, to harmonize with the size of home and the extent of the garden. Native Sophoras and Pittosporums, and the Japanese conifers known as Retinosporas, have a very handsome appearance when grown naturally, and their moderate height specially suits them for the smaller

garden. To say this selection and arrangement for garden planting is the highest form of art may be disputed, but it is certainly a very fascinating subject, with wonderful and varied possibilities.

Take delivery of the plants as soon as they are available from the nursery; heel them in in a piece of clean, friable ground, and water them if necessary. Plant them out firmly when the land is sufficiently dry to be free from any stickiness. Any open spaces that may remain should be planted with evergreen and deciduous shrubs for more or less temporary purposes. They will be chiefly required in the background, where they provide useful shelter, &c., that not only looks well, but it so beneficial and really necessary for the well-being of the more important plants in the foreground. As a guide to spacing it may be stated that 3 ft. between the smaller shrubs and 6 ft. between larger subjects may be generally allowed.

The herbaceous border and the rock-garden are interesting excursions in gardening, but they are best when severely restricted, so that they may have sufficient time and attention devoted to them. They are then admirable features.

—*W. C. Hyde, Horticulturist, Wellington.*

HYDATID TABLETS FOR DOGS.

In an article, "Prevention of Hydatid Disease in Man and Animals," published in the *Journal* for October last, and since reprinted as Bulletin No. 147, reference is made to arecoline bromide as a good agent for expelling the hydatid tapeworms from the intestines of dogs which have eaten infected offal. Hitherto there has been some difficulty in obtaining supplies of the arecoline bromide, but Messrs. Kempthorne, Prosser, and Co.'s New Zealand Drug Co., Ltd., are now placing this drug on the market in tabloid form, in bottles containing twenty doses, at a cost of 6s. 6d. One treatment with arecoline should be sufficient, but dosing again two weeks later is recommended in order to expel any further tapeworms which had entered about the time of first dosing and had not been acted upon. After a dog is dosed with the vermifuge medicine it should be chained up for two days, and its fæces burnt in a fire, preferably lit on the contaminated ground.

INTERNATIONAL VETERINARY CONGRESS, 1930.

The eleventh International Veterinary Congress will be held in London from 4th to 9th August next. A permanent committee, with headquarters at The Hague, forms a connecting-link between successive congresses and decides the programmes of meetings. Eminent veterinarians chosen from the principal countries of the world serve on this committee. A preliminary programme received includes the following particulars of the agenda:—General meetings: (1) Foot-and-mouth Disease; (2) Tuberculosis; (3) Infectious Abortion of Cattle, Sheep, and Swine; (4) Relationship of the Veterinary Surgeon to Animal Husbandry; (5) Veterinary Science in Relation to Public Health, with Special Reference to Production and Distribution of Meat and Milk; (6) Law governing the Practice of Veterinary Medicine and Surgery. Sectional meetings: Section 1, Pathology, Bacteriology, and Epizooliology—(*a*) Variola in Animals; (*b*) Anthrax; (*c*) Swine-fever; (*d*) Rabies; (*e*) Distemper; (*f*) Blackleg; (*g*) Standardization of Biological Products. Section 2, Veterinary Medicine, Surgery, and Obstetrics—(*a*) Use of Drugs in the Treatment of Diseases caused by Nematode and Trematode Worms; (*b*) Milk-fever; (*c*) Bovine Sterility; (*d*) Acute Infectious Mastitis; (*e*) Diseases of the New-born. Section 3, Tropical Diseases—(*a*) Theileriases; (*b*) Control of Trypanosomiases; (*c*) Rinderpest. Section 4, Poultry Diseases—(*a*) Fowlpox and Coryza; (*b*) Fowl Typhoid and Bacillary White Diarrhœa; (*c*) Fowl-plague; (*d*) Treatment of Parasitic Diseases. Section 5, Zootechny and Dietetics—(*a*) Genetics; (*b*) Deficiency Diseases; (*c*) Scientific Feeding of Animals. Various social functions and excursions also appear on the programme.

TESTING OF PUREBRED DAIRY COWS.

C.O.R. CLOSING LIST FOR 1929.

Dairy Division.

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS.						
Junior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Lea Rig Pearl ..	A. Christie and Co., Hikurangi	2 28	243·3	365	7,396·7	436·94
Someview Dora ..	A. E. Phillips, Maunu ..	2 68	247·3	365	8,507·8	436·60
Rainbow's Twylish Girl	G. S. Clarke, Te Awamutu ..	1 357	240·5	365	7,695·0	436·06
Linden Grove Sweet Pea	G. S. Clarke, Te Awamutu ..	1 359	240·5	326	7,066·4	416·46
Someview Lady ..	A. E. Phillips, Maunu ..	2 70	247·5	365	7,066·4	326·34
Raupo Anne ..	Boon Bros., Whakatane ..	1 317	240·5	353	4,758·0	296·22
Raupo Blossom ..	Boon Bros., Whakatane ..	1 329	240·5	301	5,065·6	294·48
Royton Ellen ..	J. Gaddes, Morrinsville ..	1 297	240·5	331	5,254·5	283·12
Butter Eyes of O.K. ..	E. Jamieson, Paeroa ..	1 284	240·5	346	4,469·2	266·84
Cook's Perfection ..	Cook Hospital Board, Gisborne	1 341	240·5	365	4,982·2	264·72
Dainty Tulip of O.K.	E. Jamieson, Paeroa ..	1 344	240·5	365	4,621·0	251·01
Four-year-old.						
Idalia's Saucy ..	A. Christie and Co., Hikurangi	4 31	316·6	365	12,062·9	695·59
St. Lambert's Superior	Boon Bros., Whakatane ..	4 306	344·1	365	9,186·1	542·13
Rosy Creek Comely ..	T. H. Western, Bell Block ..	4 40	317·5	304	9,844·6	527·61
Raupo Glory ..	Boon Bros., Whakatane ..	4 335	347·0	343	9,031·9	498·63
Mature.						
Springfield Belle ..	Mrs. J. B. Masterton, Havelock North	7 23	350·0	365	10,773·5	645·58
Adora's Jewel ..	A. Moreland and Sons, Te Rapa	9 27	350·0	341	9,111·4	441·36
Lady Gray ..	A. Moreland and Sons, Te Rapa	9 47	350·0	282	7,076·1	440·79
Xenia's Juillette ..	S. Dale, Fairlie	5 97	350·0	257	6,377·6	403·05
FRIESIANS.						
Junior Two-year-old.						
Livingstone Snowflake	W. J. Eames, Hunterville	2 77	248·2	365	13,266·2	492·25
Melrose Sylvia Echo Keyes*	T. Sherriff, Clandeboye ..	1 337	240·5	365	12,922·6	482·13
Senior Two-year-old.						
Melrose Model Queen Sylvia*	T. Sherriff, Clandeboye ..	2 263	266·8	365	14,656·0	533·40
Junior Four-year-old.						
Hobson Zozo Pontiac*	Hobson Farm, Ltd., Whare-papa	4 69	320·4	365	19,933·9	736·68
Senior Four-year-old.						
Hobson Pontiac Ormsby*	Hobson Farm, Ltd., Whare-papa	4 291	342·6	304	15,997·0	533·22
Hobson May Pontiac	Hobson Farm, Ltd., Whare-papa	4 300	343·5	305	12,800·7	444·61
Mature.						
Weston Lea Challenge Fancy*	E. F. Peacocke, Hamilton ..	9 36	350·0	354	19,022·4	529·79

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat
		Yrs. dys.	lb.		lb.	lb.
MILKING SHORTHORNS.						
Junior Four-year-old.						
Waimea Faith ..	R. V. Brown, Weraroa ..	4 25	316·0	300	9,731·8	367·68
Mature.						
Waimea Winsome ..	R. V. Brown, Weraroa ..	8 311	350·0	365	13,811·1	564·49
Waimea Lilac ..	R. V. Brown, Weraroa ..	6 302	350·0	365	12,927·1	477·06
Second-class Certificates.						
Jerseys.						
Junior Two-year-old.						
Raupo Bounty ..	Boon Bros., Whakatane ..	1 364	240·5	347	5,435·4	296·54
Raupo May ..	Boon Bros., Whakatane ..	1 328	240·5	354	5,555·6	295·99

RYDAL GIPSY (T. M. REMINGTON, WESTMERE, WANGANUI).

C.O.R. in Jersey junior two-year-old class: 8,979·5 lb. milk, 610·6 lb. butterfat.

Average Production of Canadian and New Zealand Dairy Cows.—The latest available figures indicate that Canada's average cow produces 4,745 lb. milk containing 166 lb. butterfat. New Zealand's average cow for the 1928-29 season, including all cows in milk and dry, is estimated to have produced 212 lb. butterfat. The average test in New Zealand can be taken at about 4 per cent., which represents an average milk-production of 5,300 lb.

WEATHER RECORDS: MARCH, 1930.

Dominion Meteorological Office.

General Notes.

March was an exceptionally dry month. Few places received half the average fall, and no case has yet been reported where the average was reached. North of Otago the mean deficiency was between 70 and 80 per cent., and it is only in the southern portions of Otago and in Southland that the departures from normal fall to moderate dimensions. Some places, such as Auckland, Oamaru, and Westport, had the lowest rainfall ever recorded in March, while at very many others lower totals had been recorded on two or three occasions only.

As would be expected in view of the dry conditions, there was an unusual amount of sunshine. The highest total recorded is 276·6 hours, at Nelson; but New Plymouth had 271·6, Masterton 261·6, Auckland 257·9 hours (its record for March), Napier 252·0, Hanmer 248·1, and Wellington 245·1 hours.

In spite of the fact that there was so much sunshine, temperatures were again below normal, this being the ninth in a succession of comparatively cold months. Frosts were rather numerous, and on the 27th and the 30th were severe enough to do some damage.

Owing to the heavy rains experienced in December and January, and the consequent luxuriant growth of herbage, the dry weather of March did good rather than harm. There was still an ample supply of pasture in most districts at the end of the month, and it was more fattening than at the beginning of the year. Crops of all kinds ripened well, too, and harvesting and picking operations were facilitated. At date of writing, however, rain is badly needed.

The prevailing weather during the month was of the anticyclonic type, with its characteristic clear skies and absence of wind. The anticyclones moved on an unusually far southern course, and several of them were very intense. Pressure systems in general moved rapidly and regularly from west to east. The storm systems experienced were, with one exception, of slight or moderate intensity only. Between the 6th and the 10th there were showers in most districts. These occurred mainly in the southerly winds following depressions of the westerly type which passed on the 5th and the 8th respectively. On the 23rd a depression of cyclonic form developed in the Tasman Sea and good general rains seemed imminent. But on the 24th, although the intensity of the storm had increased, its centre moved southwards across the extreme southern extremity of the Dominion. Rain was fairly widespread and there were a few heavy falls in the South Island, but a general rain was missed. The depression was preceded by strong northerly winds and followed by gales from the south-west or west.

Rainfall for March, 1930, at Representative Stations.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average March Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kaitaia	0·83	4	0·48	3·55
2	Russell	1·03	7	0·62	3·13
3	Whangarei	0·79	5	0·56	4·32
4	Auckland	0·24	3	0·21	3·03

RAINFALL FOR MARCH—*continued.*

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average March Rainfall.
	North Island - continued.				
		Inches.		Inch-s.	Inches.
5	Hamilton	0·8	3	0·36	3·88
5A	Rotorua	1·05	4	0·59	3·51
6	Kawhia	0·54	4	0·35	3·45
7	New Plymouth	1·11	6	0·62	3·62
8	Riversdale, Inglewood ..	2·37	6	1·40	7·39
9	Whangamomona	1·03	3	0·60	5·61
10	Eltham	1·07	3	0·60	4·68
11	Tairua	0·58	3	0·44	5·92
12	Tauranga	0·85	6	0·31	4·16
13	Maraehako Station, Opotiki	0·82	6	0·36	4·09
14	Gisborne	0·37	2	0·19	4·51
15	Taupo	0·45	3	0·25	3·25
16	Napier	0·18	2	0·13	3·29
17	Maraekakaho Stn., Hastings	..	..	..	3·10
18	Taihape	0·14	4	0·04	2·95
19	Masterton	0·51	5	0·33	3·15
20	Patea	1·73	6	1·10	3·62
21	Wanganui	0·63	2	0·55	2·62
22	Foxton	0·88	4	0·68	2 20
23	Wellington (Karori Reservoir)	0·46	4	0·32	3·48
	South Island.				
24	Westport	1 56	9	0·52	7·50
25	Greymouth	3·71	13	0·90	8·70
26	Hokitika	4·07	15	1·02	9·70
27	Ross	4·61	11	0·94	10·35
28	Arthur's Pass	..	..	..	9·74
29	Okuru	8·90	7	5·10	15·48
30	Collingwood	..	..	..	4·19
31	Nelson	0·43	2	0·42	3·08
32	Spring Creek	0·06	3	0·02	2·16
33	Tophouse	0·55	3	0·35	4·33
34	Hanmer Springs	0·64	5	0·39	2·89
35	Highfield, Waiau	1·04	4	0·42	3·00
36	Gore Bay	0·96	5	0·45	2·29
37	Christchurch	0·52	6	0·35	2·05
38	Timaru	1·06	9	0·58	2·31
39	Lambrook Station, Fairlie ..	0·28	2	0·15	2·47
40	Benmore Station, Clearburn	0·29	6	0·09	2·69
41	Oamaru	0·16	4	0·06	1·73
42	Queenstown	1·33	6	0·37	2·60
43	Clyde	0·19	4	0·60	1·50
44	Dunedin	0·73	9	0·25	2·98
45	Wendon	2·15	10	0·62	2·68
46	Gore	1·85	11	0·44	3·27
47	Invercargill	3·42	19	0·90	3·90
48	Puysegur Point	5·63	22	0·97	8·00
49	Half-moon Bay	4·49	16	0·91	5·79

—*Edward Kidson, Director of Meteorological Services, Wellington, 5th April, 1930.*

Fruit-export Levy.—The rate of levy for the 1930 season is fixed by the Control Board at 1¼d. per case, a reduction of ¼d. from the 1929 figure.

EMPIRE FARMERS AT RUAKURA FARM OF INSTRUCTION, HAMILTON.

This interesting gathering took place on 26th February last, when the visiting delegations from Britain and South Africa met at Ruakura the party of Australian dairy-farmers touring the North Island. The British party occupies the centre of the group, with the Australians on left and South Africans on right (of photo).

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

DOG WITH SORE FEET.

"KURI," Kohuratahi :—

I have a dog twelve months old which has had very sore and cracked feet for a few months. He has done very little work and has never been on a metalled road. The paws are quite dry and swollen. I should be grateful for information as to a cure.

The Live-stock Division :—

The condition you describe may arise from interdigital eczema or from interdigital cysts. Rest and cleanliness are important factors in bringing about recovery. The dog should be provided with a comfortable bed of straw in a clean kennel. Rest should be enforced, the dog not being allowed to pull at a chain, as young dogs are accustomed to do. The feet should be dressed daily with olive-oil, and afterwards protected with some covering. Dressing and rest should be persevered with for some weeks.

KIKUYU-GRASS FOR NORTH AUCKLAND CONDITIONS.

A. HENSLEY, Taheke, Hokianga :—

Would you please give me some information about kikuyu-grass. What kind of soil does it require? Is it liable to spread from paddock to paddock and become a nuisance? How does it compare with paspalum?

The Fields Division :—

Kikuyu-grass is a native of South Africa, and requires a warm climate and freedom from frosts to do well. The grass has an enormous root-system, and will grow on almost any class of soil provided the climate is favourable. During the early years of establishment the grass throws a large amount of feed in the late summer and early autumn, but it soon becomes sod-bound, and when in this condition produces very little feed. Kikuyu is not nearly as useful for your conditions as paspalum. The grass does not seed and must be planted out, using small pieces of the root for this purpose. Kikuyu will spread fairly readily from one paddock to another, and when planted on slips and on the higher hills, floods may carry the roots of the grass down on to the good land on the flat, and it may later become rather a nuisance in the drains and on good flat grassland.

LAME PIGS.

"P," Palmerston North :—

About six of my bacon pigs are more or less lame. I have been applying bluestone and have also tried butter of antimony. The pad of the foot (one toe only) swells, then cracks and turns septic. The pigs have been fed on skim-milk chiefly, with some green food also. They are all confined in fattening-pens with boarded floor, except one maiden sow which has been running out on grass. Advice would be appreciated.

The Live-stock Division :—

It is rather difficult to state the cause of the lameness without an examination of the premises. The infection may gain entrance through some injury to the foot. It would be advisable to thoroughly clean up and disinfect the feeding-pens, or change to a new site if possible. If the old site is retained a liberal use should be made of slaked lime to kill the infection, which would appear to originate from the soil or from the fattening-pens. Attention should be paid to drainage and sanitation. Skim-milk is not a satisfactory diet, even with green food added. Upon such a diet pigs are more liable to infection than would be the case were the diet better balanced and more liberal.

WHEAT AND OAT THRESHINGS.

TABULATED below are returns of threshings of this season's wheat and oat crops received by the Census and Statistics Office up to 19th March, covering the period January and February, 1930 :—

Land District.	Wheat.					
	Firsts.			Seconds.	Total threshed.	Average Yield per Acre.
	Tuscan or Longbury.	Hunters (Varieties).	Pearl or Velvet.			
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
North Auckland ..	..	..	..	..	..	..
Auckland ..	..	..	..	..	..	..
Gisborne ..	480	..	..	..	480	30·00
Hawke's Bay ..	6,516	..	..	505	7,021	30·79
Wellington ..	7,032	690	3,775	232	11,729	43·93
Nelson	2,563	5,213	350	537	8,663	20·04
Marlborough ..	12,662	2,679	..	1,383	16,724	27·97
Canterbury ..	1,262,789	218,566	86,767	46,851	1,614,973	31·04
Otago	45,910	25,200	14,228	5,154	90,492	32·62
Southland ..	..	..	166	6	172	21·50
Totals ..	1,337,952	252,348	105,286	54,668	1,750,254	31·08

Land District.	Oats.					
	White.	Dun.	Black.	Algerian.	Total threshed.	Average Yield per Acre.
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
North Auckland ..	..	..	..	..	..	..
Auckland ..	..	..	..	..	..	..
Hawke's Bay ..	..	..	..	5,386	5,386	42·41
Wellington ..	283	..	..	3,309	3,592	36·65
Nelson	40	..	..	1,234	1,274	26·54
Marlborough ..	749	1,442	280	5,696	8,167	34·75
Canterbury ..	145,524	48,769	4,587	77,082	275,962	37·41
Otago	32,416	5,397	746	27,515	66,074	47·26
Southland ..	..	1,464	..	..	1,464	17·22
Totals ..	179,012	57,072	5,613	120,222	361,919	38·64

FORTHCOMING WINTER SHOWS.

THE following dates have been notified by show secretaries :—

Southland A. and P. Association : Invercargill, 13th to 18th May.
Whangarei A. and P. Society : Whangarei, 13th to 17th May.
Waikato Winter Show Association : Hamilton, 27th May to 3rd June.
Otago A. and P. Society : Dunedin, 31st May to 5th June.
Wairarapa Winter Show Association : Masterton, 2nd to 7th June.
Taumarunui Winter Show Association : Taumarunui, 4th to 7th June.
Poverty Bay Winter Show Association : Gisborne, 11th to 14th June.
Manawatu A. and P. Association : Palmerston North, 17th to 21st June.
South Taranaki Winter Show Company : Hawera, 25th June to 2nd July.
Te Kuiti and District Winter Show Association : Te Kuiti, 2nd to 5th July.
Wellington Winter Show Association : Wellington, 8th to 26th July.
Auckland Winter Exhibition : Auckland, 9th to 19th July.